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Forthcoming Events.

NOVEMBER 7.

Institute of British Foundrymen (Lancashire Branch):—Ordinary meeting at Manchester. "The Production of Diesel Engine Castings in Pearlitic Cast Iron," Paper by A. J. Richman.

Institute of Mine Surveyors:—Ordinary meeting at Rotherham. "Notes on Colliery Surveying in Nigeria," Paper by W. J. Hale.

NOVEMBER 9.

Institute of Metals (Scottish Local Section):—Ordinary meeting at Glasgow. "The Binding Forces between Atoms," Paper by J. A. Cranston.

Ceramic Society:—Ordinary meeting at Stoke-on-Trent. "Researches on the Theory of Fine Grinding," Parts II and III.

NOVEMBER 10.

Staffordshire Iron and Steel Institute:—Lecture at Birmingham by D. Hanson, D.Sc.

Institute of British Foundrymen (Lancashire Branch, Burnley Section):—Ordinary meeting at Burnley. "Foundry Practice," Paper by J. Ellis.

NOVEMBER 12.

National Institute of Industrial Psychology:—Annual dinner.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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The International Market for Castings.

Of castings, there is the well-established division into pipes and "other castings." Immediately before the war, as an exporting country for cast-iron pipes, Great Britain held the second place with a return of 235,000 tons to America's 300,000 tons, though there is a little doubt as to the reliability of the latter figure. Germany was third with 72,000, and France was scarcely in the running with 5,400 tons. Last year we assumed the premier position with an export of 85,000 tons, Germany was second with 35,000, and the United States third with only 24,000. The position of France, however, has in the meantime been sufficiently changed to consider her as a real competitive factor in the world's markets for pipes. With the market reduced to one-fifth of its pre-war magnitude they increased their export tonnage from 5,400 tons to 17,000 tons. Expressed in percentages, these figures show a change from less than 0.9 to 10.5.

In the domain of "Other castings," French progress is still more striking. The position in 1913 was that Germany led the way with 137,000 tons, Great Britain was second with 81,000 tons, France third, 35,000 tons, whilst America only exported about 8,000 tons. In 1924 conditions had so changed that France had assumed the premier position with 102,000 tons, almost three times her pre-war exports. Germany was second with 83,000 tons, and Great Britain third with 31,000 tons. America increased her export tonnage by 500 tons. Expressed in percentages, these figures show that Great Britain's share of this market has been reduced from 31 to 13.9 per cent., Germany's from 53.3 to 26.9, whilst the French share has increased from 12.7 to 55.3 per cent.

It should be remembered that these figures refer to a market which had shrunk only a matter of 36,000, but Britain's loss of 17 per cent. is a serious factor. The factors which have probably been contributory are: (1) Excessive price-cutting and inflated currency have deflected a certain amount of business, especially in cast-iron pipes, to France; (2) chaos in the Russian and Chinese markets; and (3) the establishment of local foundries in the overseas markets through their desire to manufacture as much material as possible within their own borders.

An examination of these overseas markets emphasises the importance of sentiment and preferential tariffs. For instance, according to Dr. Schlunz's figures, published in "Bergwerks Zeitung," Egypt, British South Africa, British India, Ceylon, Straits Settlements, Australia, China, Peru, in 1924 bought exclusively from Great Britain, whilst Morocco, Algiers, Spain and Brazil exclusively from France, and Denmark, Holland, Roumania, Austria, Dutch East Indies, and Chilé exclusively from Germany. The position of the Argentine is especially interesting, as it absorbed 9,000 tons from Great Britain and 5,000 tons from both France and Germany. Belgium, which in pre-war days was almost Germany's exclusive preserve, imported 45,000 tons of castings from France and 1,100 from Great Britain. Last year Great Britain imported 4,000 from Germany and 8,000 from France. All these conditions tend to show that as international sentiment changes with the passing of war-feeling there will be a reorientation of these figures, and once again the basic conditions of tariffs, price, quality and delivery will be paramount.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Pearlitic Cast Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The comments on pearlitic cast iron made in your journal, including those made by "A Foundry Director" in your last issue, induce me to write the following notes:—

"A Foundry Director" asks what difference the heating up of a mould will make to a propeller casting. He states that the tip of the propeller would still cool before the remainder of the casting, etc. Towards the end of his letter he remarks "Why do they make the claims they do for a hot mould, etc.," also that the secret of homogeneous metal lies in uniformity of section?"

Experience and observation have taught me that the temperature and general condition of the mould have a very important and far-reaching effect on the quality and soundness of a casting apart from differences in section and analysis. A dried and heated mould is the best for any class or alloy of metal. Varying sections in a heated mould have a better chance to average out in temperature after the metal has entered than in a green-sand mould, also contraction strains are minimised.

Metal with a lower silicon and carbon content can be poured into a heated mould which will give a grey structure in a thin section, whereas a metal with higher silicon and carbon can be poured into a cold mould and there is white iron in the same section.

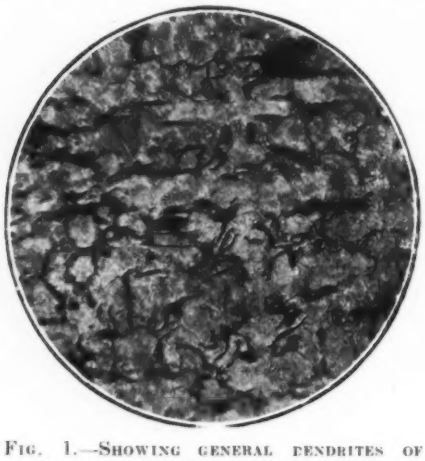

FIG. 1.—SHOWING GENERAL DENDRITES OF IRON WHICH ARE OUTLINED BY SECONDARY GRAPHITE ×60 DIAS.

Trouble with contraction strains and porosity encountered in certain steel, malleable and grey-iron castings, can be considerably reduced by pouring in heated moulds no matter what quality of iron which might be in use at the time.

The difficulties of heating up moderately large and large moulds to the temperatures required to produce pearlitic castings are in very many cases a practical impossibility and in a great number of instances very difficult and cost excessive. So far as the writer is aware there is not a method of effectually heating up say a large turbine casting mould which has been cored and closed in the foundry floor so that the required uniform temperature is secured all over the mould. I invite the proprietors of "Perlit" Iron to give proof of their ability to heat up such moulds effectively. They cannot. Small and medium moulds constructed of good refractory sand can be heated up to 400 deg. C. when necessary stove adjustments are made. Oil sand cores cannot be used in heated moulds.

The statement that a stronger bar can be obtained from a cold mould than from a hot mould is only partly true, it depends on the analysis to a great extent. It may be true of a test bar poured with a soft metal, but not true in the case of a complicated casting. If the metal used for obtaining a pearlitic structure is poured in a cold mould only white iron is secured. In this connection I will relate some of my experience in the production of pearlitic cast iron, which I can now make quite well and at a lower temperature, I believe, than by the "Perlit" method as outlined by Mr. Young. The production at a lower temperature is made possible by arranging other mould conditions.

I fixed on the necessary analysis which under certain conditions would give me pearlitic iron. Many brands of metal, white, mottled and grey, were tried in various proportions to give the required analysis. Although the right composition was secured in several adjustments of the mixtures, at the same time keeping the mould conditions as near as possible constant, only white iron was secured, until the last mixture which gave with exactly the same analysis as was obtained in the other trials an excellent pearlitic structure. This iron I can continue to make.

The analysis of the metal in the pearlitic castings came out approximately: Total carbon, 2.85; combined carbon, 0.85; graphitic carbon, 2.0; manganese, 0.6; phosphorus, 23; sulphur, 0.09 per cent. A test bar turned down from 1¼ in. dia. gave a tensile strength of 20.5 tons per sq. in., elongation only slight but noticeable.

A simple impact test was taken. A pearlitic test bar 1¼ in. dia. by 11 in. was struck by an ordinary hand hammer until a permanent bend of $\frac{3}{16}$ in. was noted. After breaking the bar,

FIG. 2.—A FINE EXAMPLE OF PEARLITIC CAST IRON BEING A PURE HOMOGENEOUS METAL WITH LOW T.C. AND SMALL AMOUNTS OF SULPHIDE AND PHOSPHIDE ×150 DIAS.

one of the pieces, approximately 5½ in. long, was placed, along with a bar of common iron the same length and dia., on a piece of sack resting on an ordinary tram rail, the bars were thus firmly seated. The common bar, which gave a tensile strength of 9½ tons per sq. in., was struck twice by a hand hammer and broken. The pearlitic bar withstood 230 blows with the same hammer and was not broken until a further 29 blows were struck with a 5 lb. sledge hammer. The resistance to impact was very remarkable and convincing.

Microphotographs were taken from the area about the centre of one of the bars and are shown in Figs. 1, 2 and 3. They indicate a very strong type of pearlitic iron. The microphotographs, for which I am indebted to Mr. R. Tullis, of Clydebank, Glasgow, are a fine piece of work.

During my first experiments when making test bars in pearlitic iron an accident occurred with the mould just as it was being closed. A piece of sand forming a joint between two bars became detached and created a wedge-shaped flash. I also arranged for a square pad 3½ in. × 3½ in. × 3½ in. in the same mould. I was surprised to find that not only was the square pad pearlitic, but also the flash which ran in places as thin as $\frac{1}{8}$ in. I also discovered that at the end of one

(*Continued on page* 398.)

Notes on the Centrifugal Casting Process with Special Reference to the Hurst-Ball Process.

By J. E. Hurst.

(*Continued from page* 365.)

The Life of Metal Moulds.

Metal moulds of any material eventually fail and become useless. The failure is due to several causes, the principal of which are the scoring and general wear and tear as a result of the continued extraction of the castings and the gradual cracking of the surface and surface disintegration due to the continual temperature changes to which the moulds are subjected. The metal mould is the principal recurring charge in the centrifugal process, and for this reason the life of the mould is a consideration of prime importance in the economy of the process.

The metals which are used for mould construction in the various systems are carbon steels, alloy steels, cast iron, and, it is thought, nichrome alloys have been tried and certainly have been suggested.

In the Hurst-Ball system cast iron has been systematically adopted for the construction of moulds, and very satisfactory life has been obtained. The design of the mould has an important bearing on the life of the moulds. Plain cylindrical moulds of uniform section give the greatest life. Failure through surface disintegration and cracking will invariably commence at any change in section. Small diameter moulds have a shorter life than large diameter moulds, and the larger the diameter of the mould the more satisfactory does cast iron become on economical grounds as the material for mould construction. The failure of the mould through general wear and tear is obviously proportional to the number of castings made. Whilst the failure through surface cracking is partially affected by the thermal conditions and the weight of material or the quantity of heat handled by the mould, it also bears some relation to the number of castings made. For these reasons the life of the die in number of castings made does not at any rate decrease with the increase in diameter. In fact, all the evidence tends to show that it might reasonably be expected to increase with increasing diameter. It is interesting to consider at this point the diametrical shrinkage of the castings. In similar castings the diametrical shrinkage is a linear function of the diameter, and is 0.009 in., or roughly 0.01 in. per inch diameter. The diametrical shrinkage on a 36-in. outside diameter casting is approximately 0.36 in., and on a 6-in. pipe is approximately 0.06 in. About two-thirds of this shrinkage takes place down to the temperature of the withdrawal of the castings. The greater clearance between the casting and the mould in the larger sizes undoubtedly has an important bearing on the mould life. For these reasons the mould costs per ton gradually decrease as the diameter of the castings increase.

The composition of the cast iron used for moulds has been discussed previously by the author. An ordinary grey iron of a close texture gives good results, and hematite irons of low-phosphorus content are probably the best. Contrary to what would be expected, it is found that a low silicon grey iron does not give nearly so consistently good results as a higher silicon, and it has been found that moulds containing 1 to 1.5 per cent. of silicon crack much more readily than those containing 2.0 to 2.5 per cent. silicon.

Some Typical Defects.

In reviewing the various defects which are encountered in castings produced by the centrifugal process, a broad conclusion can be drawn that these can be traced to the rate and velocity of pouring and the spinning speed either directly or indirectly. For this reason it is advisable to include a brief description of the principal types of these defects before considering the features of pouring and spinning speed in greater detail.

The primary function of organised pouring is, of course, to ensure correct thickness and regularity of dimensions, and for this reason defects arising from this cause are not included in the list enumerated below.

The defects likely to be encountered are as follows:—(1) Surface laps; (2) surface splashes; (3) surface depressions; (4) pinholes; (5) frothy patches on inside surfaces; and (6) characteristic roughening of inside surfaces.

If to these be added the presence of chill, eccentricity and incorrectness of weight and dimensions, it will be seen that quite an imposing list of pitfalls have to be negotiated in the successful application of this process.

The defects encountered are for the most part surface defects, and, whilst in many bad cases they may extend to a considerable depth into the surface, they are invariably self-evident from superficial examination. There is some satisfaction to be derived from this feature that, if centrifugal castings are free from superficial defects, they can be relied upon with certainty to be free from internal defects. This cannot be said of sand castings.

Surface Laps.

Surface Laps, as their name implies, consist of layers of metal not completely attached or welded into the mass of metal forming the casting. They may exist in the form of complete annular rings round the casting, and they may be unevenly distributed along the length of the casting. They very frequently show from the irregular shape of their edges that longitudinal displacement of the molten metal has occurred, thinning out the liquid metal, and thus permitting it to cool so rapidly as not to be absorbed by subsequent metal added to the mould. In the Hurst-Ball system they may be caused by the cold mould during the initial stages of warming up the mould. They are also caused by irregular pouring and incorrect speed conditions.

Splashes.

From many points of view these may be regarded as cold laps on a minute scale, and in their various stages they appear as rounded or elongated layers of comparatively small area embedded in the outside surface of the castings. They may arise from irregular pouring and incorrect velocity of pouring conditions, causing undue turbulence in the liquid metal on the mould surface. Conditions may be obtained between the velocity of the metal stream and the mould at which the molten metal is splashed across from the point of pouring to the opposite side of the mould in the form of drops which solidify in the surface of the oncoming molten metal. Such splashes are usually evenly distributed over the length of the casting. Splashes also arise when the rate of pouring and the velocity of rotation are such that the initial layers of metal supplied are extremely thin. Under these circumstances the surface tension is sufficient to break up the continuity of the liquid layer, which tends to aggregate into drops. This would be assisted by the dusty condition of the mould surface and the presence of plumbago, which is frequently used for dusting the mould surface.

Surface Depressions and Pinholes.

These troubles have been previously discussed by the author (22), and also by Williams (19). There are probably three types of pinholes, and most certainly two. Both these types are illustrated diagrammatically in Fig. 7, and in the photographs Figs. 8 and 9. Pinholes of type 1 are more prevalent in castings made by the horizontal weir-edged trough, and in castings made in cold moulds. They also appear under certain conditions when the mould is insufficiently hot. They take the form of superficial depressions

of an inverted trumpet shape, more or less evenly distributed over the surface of the casting. It is significant to note that they never appear on the flanged end of a casting, and there is invariably a short band at the extreme end of the castings free from these depressions. This is particularly noticeable in Fig. 8. This casting was produced in a mould which had been turned with a "chattering" tool in the lathe. The mould contained longitudinal "chatter" marks or hollows on the machined surface. In all cases the pinholes on the castings appear to be on straight lines, which correspond to the ridges of the "chatter" marks in the mould.

This type of pinhole is undoubtedly due to the entrapped air or gases between the casting and the mould. The above casting was poured, using a horizontal weir-edged pourer, and the air trapped in the hollows of the "chatter" depressions has been forced up the sides of the depressions under the pressure of the solidifying metal. The absence of these pinholes on the flanges, and at the ends of the castings, is due to the facility with which the air can escape through the joints of the end walls of the mould. The greater thickness of material at the flange end, on account of the longer period of time required for solidification, gives more opportunity for the gases to escape through the molten metal.

Unless the gases can advance in front of the metal stream or issue from the edges of the metal stream, they must make their way out through the molten metal. The second type of pinhole, as will be seen on reference to the sketch Fig. 7 and photograph Fig. 9, consists of narrow holes literally covering the outer surface of the casting, and extending a considerable distance into the radial depth of the casting. They may, and frequently do, extend right through the casting, ending in a tiny eruption on the inside surface, or leading into a patch of unsoundness. The unsoundness is indicated by a characteristic

FIG. 7.—SHOWS TWO DIFFERENT TYPES OF PINHOLES.

"rumpling" of the inside surface, indicating considerable gas pressure just under the surface in the partly solid metal, causing the lifting of a portion of the inner layers.

On the extreme outer edge the holes have narrow entrances and expand on entering the thickness of the casting into a pear-shaped hole. Others are parallel for a considerable distance, and end in a somewhat larger spherical hole. The pinholes are usually bright and free from oxidised surfaces.

These pinholes appear under a wide variety of conditions, indicating the complexity of their origin. They almost invariably appear when a casting sticks in the mould, and the local area at which the casting sticks is usually riddled with pinholes. In a like manner, they occur underneath laps, and they appear to be consistently produced when the temperature of the mould is too hot.

A very early observation connected the occurrence of these pinholes with the composition and condition of the molten metal. This is shown in Fig. 10, in which the percentage of pinholes is plotted against the phosphorus content of the iron over a period of casting. The increase in phosphorus content is immediately accompanied by a considerable decrease in the percentage of pinholed castings. This at once suggests that the pinholes are in some manner connected with the fluidity of the iron, and the greater the length of the fluid period due to the phosphorus content the less the number of pinholed castings, and *vice-versa*.

It is possible that in many cases the pinholes are partly due to entrapped air, and that these pinholes are a further stage of development of the type No. 1. For the most part, however, they are due to the dissolved gas evolved from the solidifying metal. Alteration in the casting conditions, casting temperature, and pouring time affect their appearance, as does also alterations in chemical composition. In this respect this type of pinhole is caused not so much by the pouring and speed conditions, but by the temperature and other thermal conditions of casting.

Surface depressions of an enlarged type occur. These take the form of elongated hollows in the direction of rotation of the casting, and often accompanied by a nest of tiny rounded pellets loosely attached to the surface at the edges of the depressions. These are due to indiscriminate and turbulent pouring, and the pellets probably result from considerable agitation of the molten metal.

Inside Surface Defects.

The appearance of lumps of solid black, spongy masses on the inside surface of the casting are probably due to the same cause. A very bad case of this is illustrated in Fig. 11. Froth of this nature is generally found on the extreme edges of the castings. This is undoubtedly due to the agitation of the molten metal during pouring and

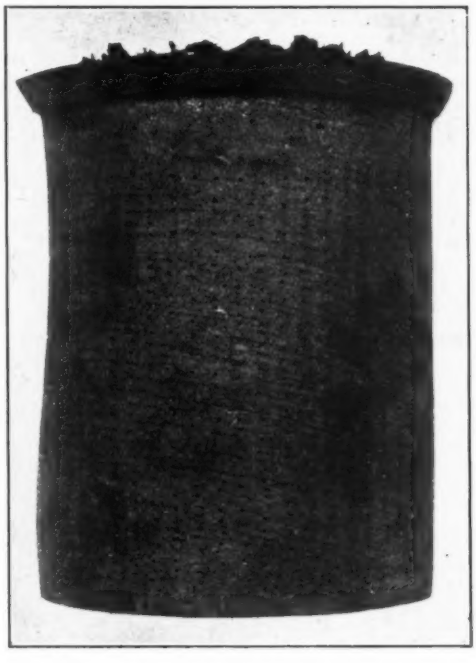

FIG. 8.—A CASTING MADE BY THE CENTRIFUGAL PROCESS, SHOWING DEFECT OF TYPE 1 OF FIG. 7.

to its dissolved gas content. There is no doubt that the pouring of molten metal is in many ways analogous to the pouring of a bottle of beer or lemonade, which can be poured in such a manner as to prevent or produce froth at will. When the liquid solidifies this froth is to be found in a solid state on the inside surfaces of the castings.

Characteristic Roughening of the Inside Surface.

Smoothness of the bore is an important feature in cast-iron pipes, although the increased tendency to adopt concrete lining probably does not render this so necessary in many cases. This fact, however, does not make it any the less important to understand why the characteristic roughness appears on the inside surfaces of castings.

Under certain conditions the castings are liable to show a very rough inside surface, which take various forms. A mild form of this is shown in Fig. 11, where the sort of "crocodile leather" pattern on the surface can be readily distinguished. This appearance is more frequently met with in thick castings over ½ in. in thickness, and is not so common to a marked extent in castings below this thickness.

The principal cause of this surface appearance is to be ascribed to the manner in which the cooling of the casting as a whole takes place. The ideal conditions of pouring appear to be those in which the last metal in the mould at any time

has almost reached the solidification point before any further supply of metal is forthcoming, so that when the final layer is poured the casting is solid almost immediately. Under these conditions the maximum liquid shrinkage of each layer has occurred before the next one is applied. If a considerable portion of the radial thickness of the casting is liquid when the pouring is finished, the liquid shrinkage and gas evolution have to take place from this considerable volume of metal, and no further supply of liquid metal is available to make good the volume changes. This shrinkage and gas evolution take place in such a manner as to leave an irregular surface. There is no doubt that for any given system of pouring there is a correct pouring time for any given dimensions of casting.

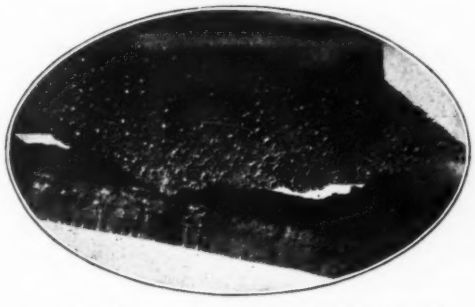

FIG. 9.—A CASTING EXHIBITING THE DEFECT, TYPE 2 OF FIG. 7.

Chemical Composition and Other Properties of the Molten Metal.

The chemical composition of the material for cast iron pipes is not of the same importance as that of cast iron for such articles as piston ring drums and cylinder liners. Whilst the chemical composition and various changes in the character of the molten metal affect the character of the finished centrifugal casting in one form or another, it is thought that it is axiomatic that cast iron of any chemical composition and character can be cast by the process providing correct adjustment is made in the relations of the velocity and quantity of pouring, and the rate of revolution of the metal. It is important to appreciate this point of view, although it is a fact that in certain cases, e.g., steel and brass, accumulated experience is not yet sufficient to specify what these conditions should be. For example, the effect of phosphorus on the reduction of pinholes present has already been illustrated. This does not infer that the adjustment of the phosphorus content is a necessary condition to the elimination of pinholes, and by correct

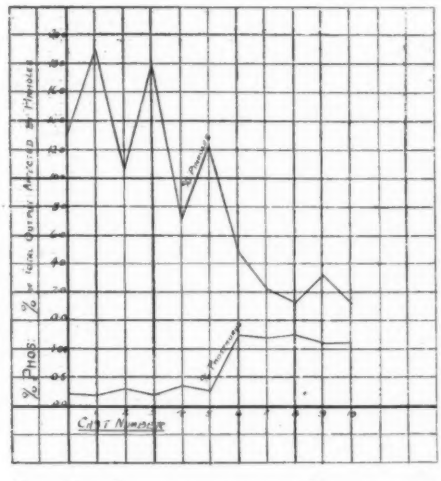

FIG. 10.—GRAPH SHOWING THE INFLUENCE OF PHOSPHORUS ON PINHOLES.

adjustment of the above-mentioned features hundreds of castings have already been made in hematite iron definitely free from pinholes.

The effect of centrifugal casting on the distribution of the constituents has already been referred to by the writer (22) and by Purdun (20).

The quantity of molten metal flowing down the tilting trough and deposited on the mould surface will vary with the fluidity of the metal for any given adjustment. As the fluidity increases the head losses of the liquid metal, in flowing over the various portions of the tilting trough mechanism, are reduced, and *vice-versa*. From this point of view the casting temperature of the molten metal is of importance. The importance of the casting temperature and its influence on the soundness of castings made in metal moulds should also be remembered.

The Application and Advantages of the Centrifugal Casting Process.

Turning to the advantages of the centrifugal casting process, the use of metal moulds at once places this process within the category of die-casting processes. The advantages of die casting, which are uniformity and regularity of dimensions, closeness of grain and rapidity of production are secured for the centrifugal process. The

FIG. 11.—THE INTERIOR SURFACE OF A DEFECTIVE CASTING.

elimination of gates and runners, the necessity for feeding heads, and the elimination of cores are additional advantages of the centrifugal process.

As in die-castings, the gases evolved from the solidifying metal must make their exit through the molten metal. In the centrifugal process, casting about the horizontal axis, the gases are constrained to pass through the metal by the shortest possible path, i.e., across the radial thickness of the casting. In doing this they are assisted by the pressure gradient across the radial thickness, and the gases pass from a condition of maximum centrifugal pressure on the outside surface to a condition of no centrifugal pressure on the inside surface of the casting. The elimination of internal blowholes and unsoundness from centrifugal castings is thus more readily secured.

The closeness of grain, which has been repeatedly shown to be accompanied by increased strength in cast iron, is largely due to the use of a metal mould. It is erroneous to ascribe this to the centrifugal pressure. The grain size is influenced by the thermal conditions of casting and of the mould, and is probably influenced by the movement of the metal during solidification. The photograph Fig. 12 gives a half-size view of the fracture of a centrifugal casting and a sand casting from the same ladle full of metal, and clearly

illustrates the difference in grain size. A casting of comparatively large cross sectional dimensions has been purposely chosen to more clearly illustrate this influence.

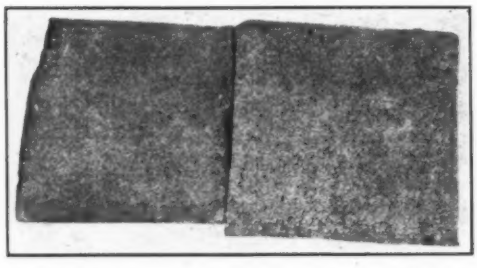

FIG. 12.—FRACTURES OF SAND (RIGHT)—AND CENTRIFUGALLY-CAST (LEFT)—CAST IRON.

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The Selling of Castings.—XXI.

BY VOYAGEUR.

For the founder there are few more economical yet at the same time effective means of selling than circularising. This does not mean that founders can adopt with certainty of success the form of postal selling known as "mail-order," or getting orders direct by return of post; but it does mean that they could use the post far more often and effectively than they do at present.

Circularising has this advantage, that it can be directed satisfactorily. When advertising a firm practically fires off a few thousand bullets in the hope of hitting a few hundred buyers. When it sends out salesmen, it sends out a few single bullets in the hope of hitting a few hundred buyers. But when it sends out circulars, it is sending out bullets each aimed and bound to reach a particular person, because the postman will ensure that they reach him. He may not read the circular. In a few cases, if he has changed his address, it may not reach him; but taking everything into account, the probability is that for a few seconds, at all events, he will hold your message in his hand.

This does not mean that circularising should take precedence over all other forms of marketing castings. It merely means that it has its place in the sales scheme, and a very important place, too. But besides its directional advantage, there are other useful points about circularising that the founder must keep in mind. First of all, it is the ideal medium for attacking a new market. It prepares the way for eventual advertising and travellers' calls. Secondly, a circular is more intimate in its approach than an advertisement, and therefore its style can be more informal. It is aimed at a person, not at a class. Thirdly, it is certain to reach its destination. It will receive at least one look, even if it is destroyed the next minute. It is in the use that he makes of that one look that the efficient circulariser differs from his rivals.

But circularising, to be really effective, depends primarily upon something not itself that makes for efficiency. That something is the mailing-list. In this it differs from advertising, and all other forms of selling. The success of an advertisement depends primarily upon the advertisement itself. The success of a salesman depends primarily upon his own initiative and skill. The success of a catalogue or booklet depends upon its design and arrangement. But the success of a circular depends largely upon the efficiency with which the mailing-list that regulates its despatch has been compiled. The older and more out-of-date a mailing-list is, the less efficient will be the circularising.

Preparation of Mailing List.

The first question the founder intent on the formation of a good mailing list will ask himself is: What names am I to include? First of all, the answer comes, he should insert no name that does not represent a past customer, a present customer, or a possible future customer. For preference, these should all be of assured financial position. Present and past customers' names and addresses can be obtained from the existing orderbooks and ledgers. Future or likely customers' names will be supplied by the representatives who travel in various districts or among certain classes of buyers, and by the agents or branch offices overseas. While salesmen do not like to have a lot of clerical work thrust upon them, it is seldom that they will object to supplying these lists, for the simple reason that they know full well how greatly a bad mailing-list damages their own work. For example, a buyer who has been knighted, or has received some honour, expects any firm writing to him to give him his proper title. To continue receiving letters addressed in such a way that he realises no notice has been taken of his promotion or honour, irritates him, and indisposes him to see that firm's representative. Similar instances might be cited, but one is enough.

The manufacturer of castings will often need to add to his list more than one official of a particular firm. For example, while the buyer may actually do the ordering of a special kind of casting, so far as signing the orders goes, the recommendation of a particular make of casting may come from the works manager or the foreman of a particular shop. In such cases, it is as well to have the names of these people on the mailing-list. If the market-analysis has not provided them, their names can often be obtained from various publications, i.e., foremen's association membership-lists, directories, small advertisements for workmen, etc. Often the castings are sold through retailers. In such cases, the retailer himself can sometimes supply lists of great value by consulting his account books. Again, agencies exist which will provide, on payment of a fee, lists of various trades, professions, industries, and so forth, which it may be worth the manufacturer's while to add. At the same time, these lists are always open to a suspicion of their up-to-dateness. There is no guarantee that they have been well-kept-up, and it is possible that money will be spent on a list that contains so many worthless names that its use is nil. Furthermore, these agencies often fail to discriminate with accuracy. They class a garage-proprietor, a civil engineer, and a locomotive-driver together under the heading of "engineers," and so on. Similarly, they often fail to discriminate between actual manufacturers of a commodity and those who merely factor it.

Therefore, the founder will do well to rely upon his own, self-compiled list. But having put together a good string of names, his work is not done. There yet remains the task of keeping this list in such a way that it shall be accessible at a moment's notice, classifying it so that reference may be made with the minimum of delay to any particular name or any particular industry, and finally, ensuring that it is up-to-date at any given moment.

Transport in Foundries.

A prominent foundryman, in a Paper presented to the American Foundrymen's Association,* pointed out that to produce one ton of machine-moulded brass castings required no less than 152 tons of handling. There is every reason to believe that in the average iron and steel foundry this figure of 152 tons would be materially increased. The present conditions of production, the keenness of competition, high wages and cost of transport, make it imperative that every possible means to efficiency, with the resultant economy, should be thoroughly explored.

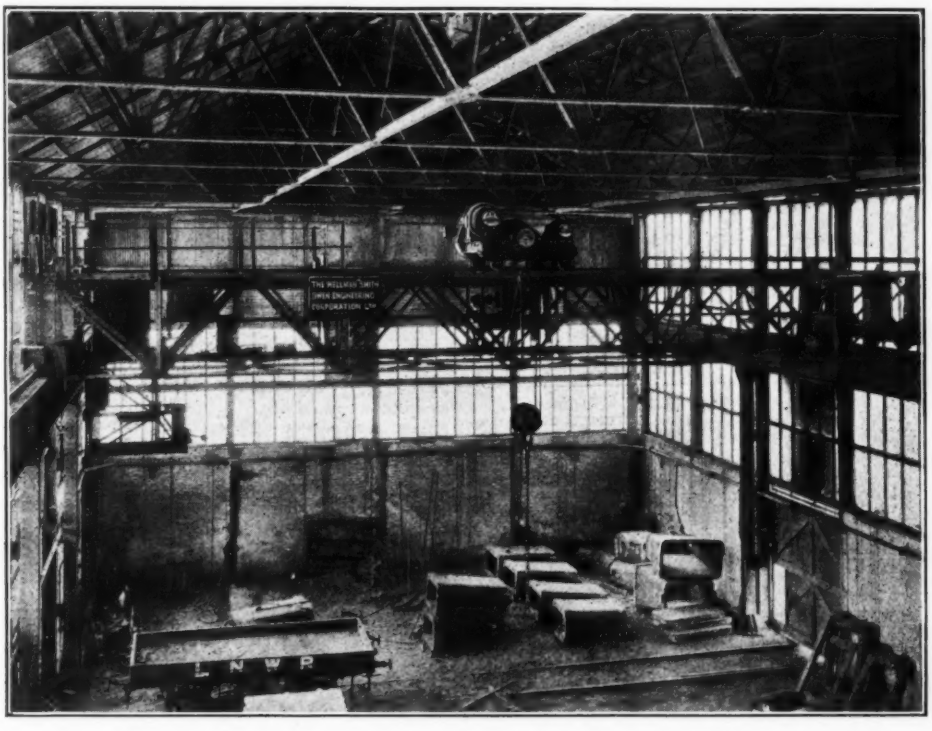


FIG. 1.—FOUNDRY CRANE, BY THE WELLMAN SMITH OWEN CORPORATION.

In any consideration of foundry transport, prominence must be given to the overhead electric travelling crane, because, with the exception of foundries making light builders' castings, it is an essential part of the scheme, but one, of course, which requires supplementing by either runways or floor transport of some form.

For evidence of the great utility of modern overhead electric cranes, and the multifarious duties which they have to perform under the most exacting conditions, it is only necessary to visit the leading steelworks in this country, where from the unloading of ore from a ship, to the despatch of the finished material, practically every operation in this extensive process of steel production involves the use of electric cranes and similar appliances.

Foundry practice, although in many respects analogous to steelworks practice, has many features which demand the crane makers' special consideration. The most prominent of these are the exclusion of the grit and dust of the foundry atmosphere, so harmful to working parts, and also provision for the numerous duties which the foundry crane has to perform. It is evident that leading crane makers are now giving these points their attention in the designing of hoisting machinery for foundry service, and in this connection it is interesting to examine the prominent characteristics of a type of crane (Fig. 1) recently introduced by the Wellman Smith Owen Engineering Corporation, Limited, of Kern House, Kingsway, London, W.C.2, and Darlaston, which, it is understood, has now been standardised by this firm. The crane, which is of the electric overhead travelling type, has several noteworthy features, of which the special crab (Fig. 2), which has been designed primarily to meet the requirements of iron and steel foundries, is undoubtedly the most interesting.

The side frames are of box section in cast iron and are designed so that the stress per square inch of net section will not exceed 0.5 tons when fully loaded. One side frame forms the lower half of the hoisting gear case.

It will be observed that all working parts are entirely protected from the dust and grit of the atmosphere, which is injurious to gearing. The gears operate in a constant bath of lubricant within the totally enclosed cast-iron cases which contain the bearings, and are parted on the vertical or horizontal. It is hardly necessary to mention that such an arrangement makes for efficiency, durability and noiseless running. At the same time, every part is easily accessible for examination, and adjustment, as will be seen from Fig. 3, which shows the crab with top gear covers removed.

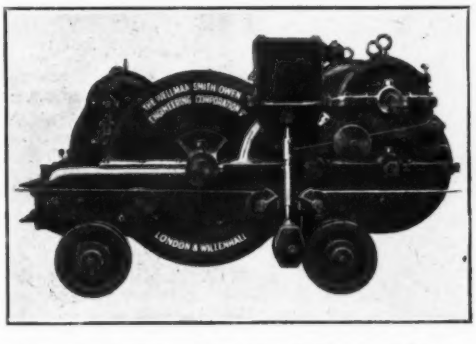


FIG. 2.—TOTALLY ENCLOSED DUSTPROOF CRAB, BY THE WELLMAN SMITH OWEN CORPORATION.

An important characteristic of the crane is the provision for the prevention of snatching at the commencement of the lifting motion. The evils of jerking the load, particularly when sand is being handled, are patent to foundrymen. This difficulty

* See last week's issue, page 375.

has now been overcome by the incorporation of special slow speed notches in the control gear, thus ensuring a creeping speed when the load is taken up.

In order to cope with the manifold duties which the foundry crane has to perform, and also to extend its usefulness, the makers of this crane have so designed the crab that a hoisting magnet can readily be fitted, where it is desired to handle pig-iron, scrap, castings and other materials by this means. The labour-saving potentialities to be associated with electro-magnets on this class of work are too obvious to call for further comment.

In general construction the crane follows the line of modern practice, having main girders of "H" section, box section, or braced type, according to capacity and span, with end carriage having a wheel base of not less than one-fifth of the span. Each end carriage is fitted with two large diameter

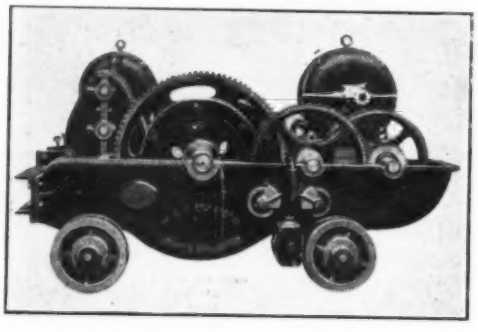


FIG. 3.—SHOWING THE ACCESSIBILITY OF THE CRAB SHOWN IN FIG. 2.

double-flanged travelling wheels, one of which carries a long travel driving spur ring. Longitudinal travelling is effected by a motor situated at or near the centre of the span, and the motion is transmitted by a single shaft extending across the girders to the end carriages, ensuring simultaneous travel at both ends of the crane.

A powerful brake of the post type is fitted to the cross shaft, and arranged for operation by a foot lever located in the driver's cage. The cage is situated at one end of the crane, sufficiently to one side to clear the crab, hoisting rope falls, and return block, and to give the driver an unobstructed view of the load in all positions.

The question of efficient hoisting equipment in the foundry is one which demands the very careful consideration of those who are responsible for the general policy of their business, and it is hoped that the simple facts outlined in the foregoing may be the means of stimulating a desire for still greater efficiency in this direction.

Magnet Steels.

In the course of a Paper on "Some Factors Affecting Coercive Force and Residual Induction of some Magnet Steels," read by MESSRS. J. R. ADAMS and F. E. GOECKLER at the Seventh Annual Convention of the American Society for Steel Treating, Cleveland, in September, they point out that in connection with plain carbon magnet steels the amount of carbon present is an important factor, in that it increases the coercive force, but, at the same time, decreases the residual induction. Above approximately 1.00 per cent. carbon the benefits derived from further addition of carbon with respect to increasing the coercive force are of little value, when the magnets are quenched from 800 deg. Cent. If, however, the quenching temperature is raised the coercive force continues to rise with an increasing carbon content, but at a slower rate than observed below 1.00 per cent. carbon. It is impractical, however, to quench magnets from a temperature as high as that necessary to take advantage of the rise in coercive force produced by the higher carbon content, so that few magnets are made from steel containing more than 1.00 per cent. of carbon.

Tungsten magnet steel is a binary steel, the relation between the various constituents being quite complex. The addition of tungsten to plain carbon magnet steel raises the coercive force, and, at the same time, maintains the residual induction at a high value, but the optimum percentage of carbon is not generally considered to be 1.00 per cent. but in the neighbourhood of 0.60 per cent.

The recent commercial trend in permanent magnets has been toward chromium steels. They originally started with comparatively low percentages of chromium, but at the present time there is a strong tendency towards higher chromium, using up to as high as 6.00 per cent. So far the results obtained indicate that the increase in magnetic values obtained from greater percentages of chromium than 4.00 per cent. are not commensurate with the increased cost. The highest combination of residual induction and coercive force seems to lie in the neighbourhood of 4.00 per cent. chromium. The addition of 0.34 per cent. tungsten to 4.00 per cent. chromium and 1.00 per cent. carbon steel has no marked effect, but on adding 0.24 per cent. vanadium to 4.00 per cent. chromium and 1.00 per cent. carbon steel it is found necessary to raise the hardening temperature over that ordinarily used in order to obtain the full values of the 4.00 per cent. chromium steel; but no treatment of the steel containing vanadium causes any increase in coercive force or residual induction over that obtained from 4.00 per cent. chromium and 1.00 per cent. carbon steel. The chromium steels have the marked advantage over the tungsten steels in that they give their best values with an oil quench, while the tungsten steels are water-quenching steels. Combinations of chromium-cobalt-tungsten and manganese give exceedingly high coercive forces coupled with good residual inductions. These high alloy steels, however, are exceedingly hard to work, and in addition their value in the form of permanent magnets is still indeterminate.

The fact that annealing billets, prolonged heating, and slow cooling in manufacturing operations are all detrimental to the final magnetic qualities of the steel may be partially explained by dissociation of some of the compounds in the steel and coalescing of some of the constituents. It is difficult actually to demonstrate this experimentally, due to lack of absolute control of the above-mentioned operations, where one factor may be deliberately changed, while some other factor may have changed inadvertently during the experiment, but average results obtained over long periods of production demonstrate the above to be correct.

The reaction that occurs in the tungsten steel is not so clear. The indications are that the effects noticed are only due to agglomeration of the carbides without dissociation of the constituent, but the sudden drop in coercive force noticeable on heating to 980 deg. Cent. for one hour and cooling slowly indicates that some further change takes place somewhere above 925 deg. Cent.

When softening for machining after forging, bending, etc., is required, loss in magnetic values must be expected. Whenever it is possible to avoid the softening of magnet steel for whatever purpose after its initial rolling or forging, it should be done. In the hardening operation a procedure should be adopted that will permit of the holding of the magnets at the quenching temperature the least time possible to obtain the maximum magnetic values.

A factor that must be borne in mind in treating and quenching magnet steel is the obtaining of the maximum amount of carbides in solution, the best conditions for which are the best conditions for the detrimental dissociation of the carbides, so the conditions that will permit of the maximum amount of carbides in solution with the minimum amount of dissociation should be adopted.

Magnesite Output of Venezuela.—All the magnesite produced in Venezuela so far has been exported. Official statistics begin with the second half of 1913, when 2,000 tons were shipped. Figures for the following years were :—300 tons in 1914; 5,300 in 1915; 6,360 in 1916; 1,700 in 1917; none in 1918 or 1919; 2,000 in 1920; and 2,400 in 1921. All these shipments were sent to the United States except the 2,000 tons in 1920, which went to Great Britain.

The Effects of Some Modifications of a Rapid Annealing Method on the Physical Properties of Malleable Iron.*

By Anson Hayes, E. Lee Henderson and G. R. Hosmer, Ames, Iowa.

Previous work done by other investigators as well as that done in this laboratory, in attempts to produce completely malleabilised cast iron in short annealing periods, has resulted in a product which is somewhat inferior to the best material produced by the present commercial methods of annealing. Usually the ductility has been 2 or 3 per cent. less and the tensile strength 0.9 to 1.8 ton less than the commercial product where complete graphitisation was brought about by the rapid annealing method.

This paper is a preliminary report of a careful study that is being made of the influences of

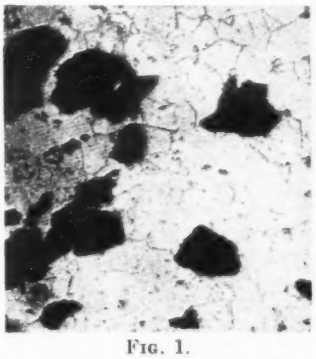


FIG. 1.

Initial high temperature produced variable grain size and lowered the tensile strength—x 120—average tensile strength = 49,000. Average ductility = 21 per cent.

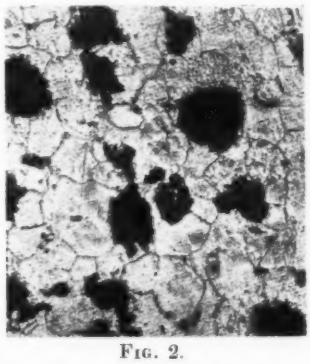


FIG. 2.

Preliminary treatment at a lower temperature produced a finer grain structure which duplicated tensile strength and gave ductility within 2 per cent. of the commercial anneal — x 120 — average tensile strength = 51,800. Average ductility = 20 per cent.

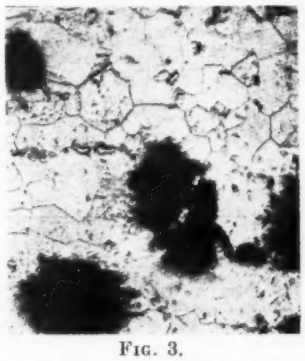


FIG. 3.

Presence of fragments of free iron carbide reduced the ductility slightly—x 120—average tensile strength=50,100. Average ductility = 19 per cent.

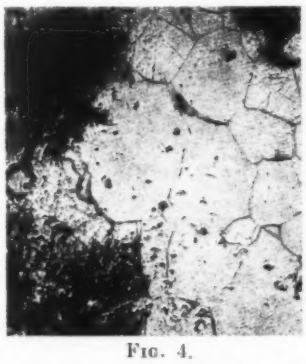


FIG. 4.

Long period at high temperature produced very coarse grain structure, lowering tensile strength and ductility—x 95—tensile strength = 48,800 (average). Average ductility = 19 per cent.

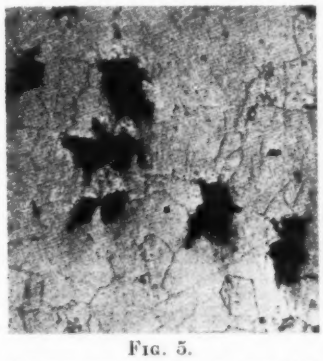


FIG. 5.

A slower rate of cooling to the critical range than was used under (3) allowed more complete absorption of free iron carbide—x 120—average tensile strength = 50,800. Average ductility = 22 per cent.

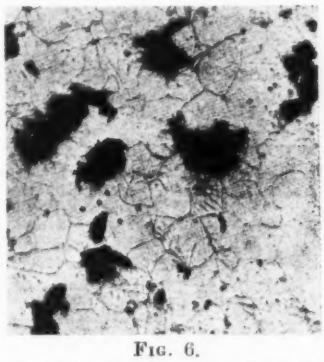


FIG. 6.

No further benefit resulted with a still lower rate of cooling to the critical range than was used under (5)—x 120—average tensile strength = 50,000. Average ductility = 21 per cent.

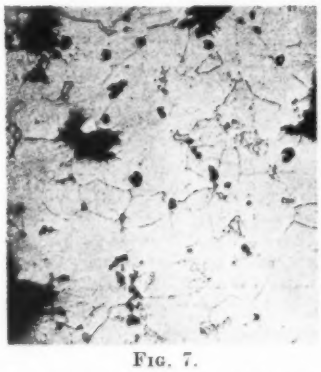


FIG. 7.

Too short a time at the high temperature leaves fragments of free iron carbide and some pearlite. The ductility is reduced—x 120—average tensile strength = 50,700. Average ductility = 17 per cent.

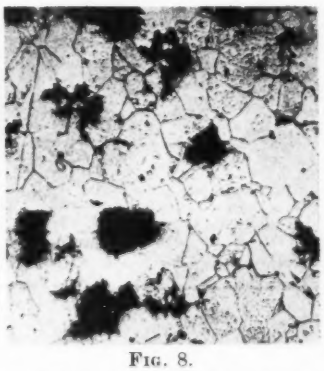


FIG. 8.

Preliminary annealing treatment at a lower temperature (878 deg. C.) again resulted in physical properties comparable to those of the commercial anneal by the non-oxidising pack—x 120—average tensile strength = 50,300. Average ductility = 22 per cent.

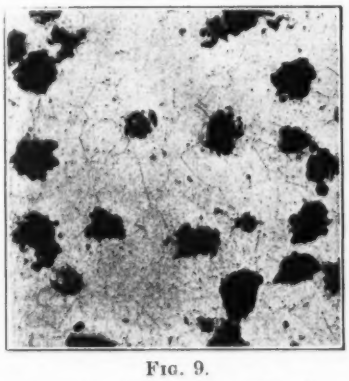


FIG. 9.

Fine grain structure and small unit carbon shots associated with good physical properties—x 120—average tensile strength=23 tons. Average ductility=22 per cent.

* A Paper read before the Syracuse Meeting of the American Foundrymen's Association. The Authors are on the Staff of the Iowa State College.

modifications of various rapid methods of annealing upon the physical properties of the product.

Although in recent years, through the influence of the American Malleable Castings Association, a very great improvement has been made in the properties of malleable iron, the authors feel that there is nothing in the inherent nature of the rapid method used in the larger portion of the work at Iowa State College that would prevent a complete duplication of the best properties produced by the present industrial method. In certain respects it would seem that properties superior to those produced by the present methods might be expected.

Because a satisfactory duplication of the physical properties of some excellent malleable iron has already been obtained it is hoped that this brief preliminary report will be of interest.

were packed in a mixture of 50 per cent. rolling mill scale and 50 per cent. crushed furnace slag. They show a considerable thickness of decarbonised material on the surface of the bars. The commercially annealed bars showing the lower ductility were packed in crushed furnace slag and show almost no decarbonisation on the surface.

Summary and Discussion.

From the results shown in Table 1, and by the accompanying figures, the conclusion is drawn that any annealing method which produces small grain structure and well rounded carbon spots, and which results in complete graphitisation, will duplicate the physical properties of the malleable iron produced by the present commercial methods. Such properties can be duplicated in annealing periods of 40 hrs. or less.

Table I.

Method of treatment.	Overall time.	Tensile strength.	Yield point by dividers.	Elongation in 2 inches.
	Hours.	Pounds per square inch.	Pounds per square inch.	Per cent.
(1) 1 hr. at 982°C., 4 hrs. at 927°C., cooled to 777°C. in 2 hrs. and 40 m.; cooled from 777°C. to 672°C. in 18 hrs.; cooling rate through critical range, 5.8°C. per hr.	29.5	49,000 48,300 49,600	32,700 32,000 33,300	18.5 21.0 22.5
(2) 4 hrs. and 35 m. at 871°C.; heated to 927°C. in 25 m.; 5 hrs. at 927°C.; cooled to 782°C. in 1 hr. and 45 m.; cooled from 782°C. to 674°C. in 18 hrs.; cooling rate through critical range, 6°C. per hr.	33.0	51,400 51,400 52,500	33,300 33,200 33,200	18.5 20.0 21.5
(3) 5 hrs. at 927°C.; cooled to 777°C. in 1 hr. and 45 m.; cooled from 777°C. to 668°C. in 19 hrs.; cooling rate through critical range, 5.7°C. per hr.	29.0	50,000 49,700 50,600	32,500 33,000 31,700	18.0 19.0 20.0
(4) 9 hrs. at 949°C.; cooled to 779°C. in 2 hrs. and 50 m.; cooled from 779°C. to 671°C. in 17.5 hrs.; cooling rate through critical range, 6.2°C. per hr.	32.5	48,800 48,800	30,900 30,900	18.0 20.5
(5) 4 hrs. at 949°C.; cooled to 774°C. in 2 hrs. and 45 m.; cooled from 774°C. to 674°C. in 22.75 hrs.; cooling rate through critical range, 4.4°C. per hr.	33.0	50,600 51,000	33,600 33,700	21.0 22.5
(6) 4.25 hrs. at 949°C.; cooled to 774°C. in 4 hrs. and 45 m.; cooled from 774°C. to 663°C. in 24 hrs. and 15 m.; cooling rate through critical range, 4.6°C. per hr.	32.0	50,600 49,400	32,300 34,200	19.0 22.5
(7) 2 hrs. at 949°C.; cooled to 774°C. in 5 hrs.; cooled from 774°C. to 668°C. in 23 hrs.; cooling rate through critical range, 4.6°C. per hr.	31.7	33,600 49,700	33,600 33,400	17.0 18.0
(8) 4 hrs. at 878°C.; heated to 935°C. in 25 m.; 5 hrs. at 935°C.; cooled from 935°C. to 779°C. in 2 hrs. and 40 m.; cooled from 779°C. to 674°C. in 27 hrs.; cooling rate through critical range, 4°C. per hr.	41.0	50,400 50,300	32,700 32,200	22.0 21.5
Commercially annealed in Neutral Pack ..		51,900 51,300 52,100	33,900 35,300 34,000	23.0 21.5 20.5
Commercially annealed in Oxidising Pack ..		50,400 50,800	32,800 33,800	23.5 25.0

This study was centred around an investigation of:—

(1) Effects of time at the high temperature (949 deg. C.); (2) effects of rates of cooling to the critical temperature (771 deg. C.); and (3) effects of rates of cooling through the critical range (771 to 677 deg. C.).

The study as herein outlined is not yet complete on any of these phases. The composition of the white cast iron used in this investigation in the preparation of the malleabilised iron was Si., 0.94; S., 0.032; P., 0.151; Mn., 0.26 and total carbon, 2.23 per cent. Test bars from the same heat were annealed by the Iowa Malleable Iron Company at Fairfield, Iowa, who furnished the white iron test bars used in this experimental work.

The bars which were annealed by the commercial method, and which show the highest ductility,

The failure to duplicate the slightly higher ductility of the commercially annealed product from the oxidising pack is very probably due to the reduction in the amount of temper carbon produced by such a pack.

The Reich Railway authorities are reported to have allotted orders to the German Steel Syndicate for a total quantity of 450,000 tons of permanent-way material to be delivered in monthly tonnages of about 80,000 by the end of next May. The total seems to represent about the pre-war efficiency of the works in rails, switches and fastenings, sleepers, etc. The contract price is said to be below that of bar steel (135 marks at store), which is considered by the works and the syndicate to be advantageous to them, having regard to the method of payment of the Reich Railways. So far, however, there is no question of the placing of orders for rolling stock.

The Carbon Content of Pearlite in Iron-Carbon Alloys Containing One Per Cent. Silicon.*

By Anson Hayes and H. U. Wakefield.

As a result of an investigation of the graphitising properties of iron-carbon alloys of white iron composition, with which one of the authors has been engaged for the past four years, a modification of the diagram for pure iron-carbon alloys was recently published.[1] [2]

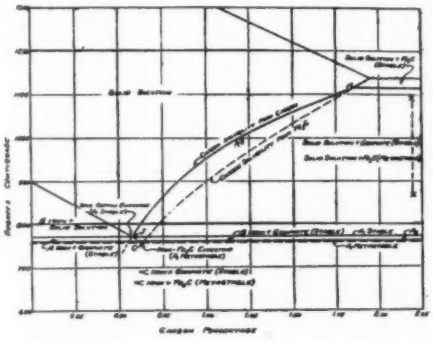


FIG. 1.—CONSTITUTIONAL DIAGRAM FOR IRON-CARBON ALLOYS OF WHITE CAST-IRON COMPOSITION.

This modified diagram is shown in Fig. 1. It was constructed to conform to such experimental data as was available at that time. For convenience the sources of the experimental work will be repeated here. For the temperatures of points J and C, the extrapolation values of Hayes, Flanders and Moore[3] were used. They are 771 deg. C. and 759 deg. C. respectively. The equilibrium carbon concentration at point J was taken from Schwartz[4] as 0.57 per cent.

The carbon concentration of point C had not been determined at the time Bulletin 71 of the Engineering Experiment Station was issued.

What is believed to be a good value for the carbon content of this point has since been obtained, and the principal object of this Paper is to report the findings in this investigation.

The intersection of the A_3 line with the temperature axis was taken at 900 deg. C. This is in accordance with the observations of Gonterman,[5] in which he states, "In Osmonds (iron-silicon) alloys the temperature of transformation from gamma to beta iron was almost independent of the silicon percentage."

With those presented by Yensen,[6] in which the iron-silicon diagram shows only a slight rise in the gamma to beta transformation even up to 8 per cent. silicon, and also with the statement of Charpy and Cornu-Thenard,[7] "The authors are able to confirm as different observers have pointed out that the A_3 point rapidly decreases (in intensity) when the percentage of silicon rises, at the same time rising slightly on the temperature scale."

The A_3 line was then drawn through the point whose co-ordinates are 0.57 per cent. carbon and 771 deg. C. It was then extended through J until

TABLE I.—*Data for Relative Areas of Pearlite and Ferrite for Alloy No.* 1.

Section No.	Area as counted: Pearlite.	Ferrite.	Spots.	Total.
I ..	53.5	45.0	2.0	
	43.5	53.0	0.5	
	37.0	62.5	1.0	
	38.0	62.5	1.5	
	50.5	47.0	2.0	
MEAN	44.5	54.0	1.4	98.9
II ..	49.0	54.0	0.5	
	52.5	47.0	1.0	
	41.5	58.5	0.0	
	34.0	64.5	1.5	
	43.0	57.0	1.0	
MEAN	44.0	56.2	0.8	101.0
III ..	37.5	66.5	0.0	
	48.0	47.0	1.0	
	43.0	54.0	0.5	
	49.5	51.0	1.5	
	45.0	54.5	0.0	
MEAN	44.7	54.6	0.6	99.9
IV ..	66.0	33.5	0.0	
	41.0	58.0	2.0	
	49.5	49.0	0.0	
	45.0	32.0	0.0	
	38.5	59.0	3.5	
MEAN	48.0	49.9	1.1	101.0
MEAN OF ALL VALUES	45.30	53.68	0.98	99.60

Considering only pearlite and ferrite, part of area covered by each:
Pearlite 45.77 per cent.
Ferrite 54.23 per cent.

TABLE II.—*Data for Relative Areas of Pearlite and Ferrite for Alloy No.* 3.

Section No.	Area as counted: Pearlite.	Ferrite.	Spots.	Total.
I ..	42.0	60.0	4.5	
	42.0	60.0	1.5	
	40.5	60.0	2.5	
	35.5	61.0	5.0	
	51.5	50.0	1.0	
MEAN	42.3	58.2	2.9	103.4
II ..	33.5	65.5	3.0	
	41.5	56.5	3.5	
	40.5	50.0	9.0	
	43.5	55.5	3.0	
	45.0	55.0	0.0	
MEAN	40.7	56.5	3.7	100.9
III ..	42.0	58.5	2.0	
	38.5	57.5	3.5	
	41.5	58.5	0.5	
	45.0	55.5	0.5	
	42.0	56.5	2.5	
MEAN	41.8	57.3	1.6	100.7
IV ..	40.5	60.5	1.0	
	44.5	51.0	2.5	
	42.0	52.5	3.5	
	43.5	51.0	3.5	
	36.5	62.5	2.5	
MEAN	41.6	55.5	2.6	99.7
MEAN OF ALL VALUES	41.60	56.88	2.70	101.18

Considering only pearlite and ferrite, part of area covered by each:
Pearlite 42.22 per cent.
Ferrite 57.78 per cent.

* A Paper read before the American Society for Steel Treating. Dr. Anson Hayes is Professor of Physical Chemistry and Metallography, Iowa State College, Ames, Iowa. H. U. Wakefield is associated with Dr. Hayes.

[1] Anson Hayes, W. J. Diederichs, and H. E. Flanders, Bulletin 71, Engineering Experiment Station, Iowa State College (1924).

[2] Also, Preprint No. 427, American Foundrymen's Association, October 11, 1924.

[3] TRANSACTIONS, American Society for Steel Treating, Vol. 5, p. 183 (1924).

[4] Schwartz, Payne, Gorton and Austin, Conditions of Stable Equilibrium in Iron Carbon Alloys, *Transactions*, American Institute of Mining and Metallurgical Engineers, 68, 916.

[5] Gonterman, *Journal*, Iron and Steel Institute, No. 1, p. 432 (1911).

[6] Engineering Experiment Station, Bulletin No. 93, University of Illinois, p. 16.

[7] *Journal*, Iron and Steel Institute, No. 1, p. 301 (1915).

the temperature corresponding to 759 deg. C. was reached. This value was that obtained by Hayes, Flanders and Moore.[8]

This method gives a value of 0.64 per cent. for the carbon content of point C, *i.e.*, of pearlite. This projection of the straight line to point C was made possible by the work of Scott,[9] which places the A_3 line at 761 deg. C. in an iron-carbon alloy containing 1 per cent. silicon. This is only 2 deg. C. above A_1 metastable, as stated above.

The rather interesting fact that point J (the iron-carbon eutectoid) falls nearly on the A_3 line of the pure iron-carbon diagram was noticed at the time the work published under reference (3) was completed. The method just given for locating point C, of course, places it on this same A_3 line.

The value for the carbon content of pearlite in a 1 per cent. silicon alloy obtained in the present investigation, when used with the temperature value 759 deg. C. for a 1 per cent. silicon alloy, proves to be in satisfactory agreement with this manner of drawing the A_3 line. That is, both points J and C (A_1 stable and A_1 metastable) occur almost exactly upon the same A_3 line.

[NOTE.—While it is possible to predict that points J and C would be very nearly on the same straight line, A_2 being as near A_1 metastable, it is considered rather an accident that the A_3 line for the pure iron-carbon system and that for a 1 per cent. silicon alloy would have the same slope and thus coincide.]

This may be considered strong evidence that the solid solution formed from carbon and that

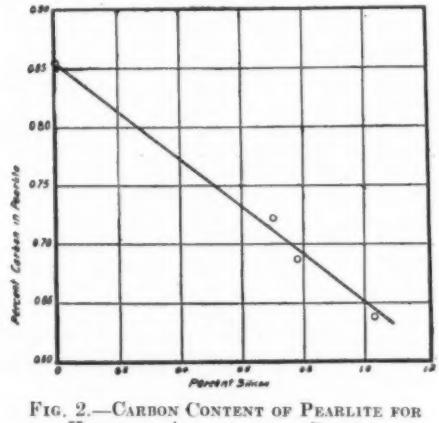


FIG. 2.—CARBON CONTENT OF PEARLITE FOR VARYING AMOUNTS OF CARBON AND SILICON.

from iron-carbide are the same. They probably differ only in the concentration of dissolved carbon which represents austenite saturated with carbon from carbon in one case, and carbon from the metastable body iron-carbide in the other. It may be possible that all of the dissolved carbon is not in the same form. There may be various forms of the dissolved substance in solution, as is the case in liquid solution. If such is the case, an equilibrium between the various forms probably exists, whether one form exists or whether two or more forms of dissolved carbon are in equilibrium. It is to be expected that beta iron will separate where the carbon solubility line from carbon intersects the A_3 line for a 1 per cent. silicon alloy. Furthermore, alpha iron should separate from the solid solution where the Acm line intersects the A_{2-3} line. Since the A_2 line is so near the temperature of A_1, this places both A_1 stable and A_1 metastable on essentially the same straight line drawn from 900 deg. C. and zero carbon concentration.

There probably is considerable doubt as to whether the point A of Fig. 1 should be above or below the solidification temperature for austenite in equilibrium with cementite. In any case its exact location is not known. It was placed below the solidification temperature of these two bodies in conformity with the conclusions of Honda,[10] that iron-carbide is stable immediately below its solidification temperature.

The line AJ was obtained by drawing a smooth curve through the lowest solubility values given by Schwartz. The line AC was drawn to connect A and C and to fall to the right of all values obtained by Schwartz. Its experimental determination from solubility studies would offer grave experimental difficulties.

Method of Determining Carbon Content of Pearlite as a Function of the Silicon Content.

The chief assumption made as a basis for the determination is that the fraction of the area of the cross-section covered by pearlite in an alloy of any particular silicon content is proportional to the combined carbon content.

Alloys of varying silicon content and containing combined carbon of such a value as to produce sufficient pearlite to cover from 30 to 60 per cent. of the cross-sectional area were made up. The areas of ferrite and pearlite were then carefully measured. The samples were then milled up and determinations for carbon and silicon were made.

The carbon content of pearlite was then calculated by dividing the combined carbon content by the fraction of the area covered by pearlite. The per cent. of carbon in pearlite thus obtained was then plotted against the silicon content. By drawing a smooth curve through the points so obtained values of the carbon content of pearlite for any silicon content within the range of this investigation may be interpolated. This is shown in Fig. 2.

The alloys were made by melting in a magnesite crucible armco iron to which had been added the necessary quantities of pure graphite and ferro-silicon. They were allowed to cool in the furnace at such a rate that well-defined pearlite was formed. An effort was made to use the same rates of cooling for the various alloys, since it was thought that the carbon content of pearlite might vary somewhat with the rates of cooling. Slugs weighing about 100 grammes were made.

These were sawed apart at four places and four of the exposed faces were measured. The areas of pearlite, ferrite, and spots were measured on five fields chosen at random on any face, and the mean value was obtained.

If the sample showed lack of uniformity in its structure, another was prepared. Tables I and II give typical data resulting from such measurements. In Table III is shown the results for the four alloys investigated. The data of Table III is plotted in Fig. 2.

TABLE III.—*Data for the Alloys Used to Determine the Carbon Content of Pearlite for Varying Amounts of Carbon and Silicon.*

No. of alloy	Pearlite.	Ferrite.	Combined carbon.	Graphitic carbon.	Silicon	Carbon content of pearlite.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	45.77	54.23	0.3895	No evidence of any.	None	0.851
2	65.29	34.71	0.4709	Trace.	0.710	0.7213
3	42.22	57.78	0.289	Less than 0.004	0.789	0.6845
4	71.06	28.94	0.468	0.013	1.113	0.6403

Interpolation on this graph gives 0.650 per cent. for the carbon content of pearlite for an alloy containing 1 per cent. silicon.

The agreement is well within the experimental error for the location of point C on the diagram of Fig. 1.

[8] *Ibid.*
[9] *Chemical and Metallurgical Engineering*, 28, 212 (1923).
[10] *Science Report* Tohoku Imperial University, 1st Series, No. 11, p. 119 (1922).

A Useful Foundry Tool.

Mr. R. H. Bowen, before the Sheffield Foundry Trade Society, read a Paper on "Slide-rule Practice in the Foundry." The lecturer, who is a Sheffield moulder, spoke of the usefulness of the slide-rule, showing how simple it was to get out weights of castings and moulds, etc. He stated that the Society was making an application to the Department of Applied Science for a special course of lectures on this subject, as a large number of moulders in Sheffield were anxious to gain further knowledge.

The Franco-Belgian Foundry Congress.

The Franco-Belgian Foundry Congress, which opened on October 25, was a complete success, no less than five nationalities being represented. At the opening ceremony, over which Mons. G. Masson presided, there were present on the platform Mons. Ramas (president of the French Association); the Governor of the Province of Liège; the Mayor of Liège; the Rector of the local University; the Italian and French Consuls. Amongst other well-known men in the foundry world who took part in the proceedings were Mr. J. E. Hurst, who presented a Paper on behalf of the Institute of British Foundrymen on Centrifugal Castings; Mons. Ronceray, of Paris; Prof. Trasenter, of Liège; Mons. J. M. Espana, of Paris; Prof. Portevin, of Paris; and Signor Com. Mg. Vansetti, of the Milan Steel Foundry Company.

PRESIDENTIAL ADDRESS.

The proceedings were opened by a Presidential Address by Mons. Masson, in the course of which he reminded his audience that four years ago in the same room there was held the first joint congress to be organised since the end of the war, together with the first foundry exhibition.

MONS. E. RAMAS,
President of the Association Technique de Fonderie (France).

The 1921 Congress was the starting point for the serious international study of a series of extremely interesting problems, amongst which the strength of cast iron and methods of testing were of outstanding importance. The president was of opinion that considerable progress had been made and the day of their solution was materially nearer. The ever-present question of wasters was still to be found in every foundry, but much more light had been shed upon the question. Malleable cast iron had similarly been dealt with, and continuous research was in progress.

In the other congresses which followed that of 1921 the Belgian Association had invariably taken its share of the work by the contribution of individual Papers or committee reports. Mons. Masson said he could imagine nothing of greater importance to the foundry industry than the regular holding of international meetings, where foundrymen could follow the progress of science by interesting themselves in the work of the recognised leaders of thought in that particular sphere. "In 1930," said the President, "his Association had the intention of calling an International meeting of foundrymen, as this date coincided with the Centenary of Belgian national independence."

After pointing out that the Congress was more than a Franco-Belgian one, as several other nationalities were present, the chairman closed his remarks, as is customary on the Continent, by thanking individually all the more important people for their support.

Mons. Ramas responded on behalf of the visitors, and was offered the chairmanship. Papers were read by Mons. J. H. Fleming, Senor Joaquin Ferrer, Mr. J. W. Bolton, Mons. Le Thomas and Capt. Augustin Planas.

Lunch was taken at the Hotel de l'Europe and the afternoon was devoted to sight-seeing.

On Monday morning, Mons. Lamoureux, a vice-president of the Belgian Association, took the chair, and Papers by Mr. J. G. Pearce (Director of the British Cast Iron Research Association); M. M. Sappin; Mons. de Fleury and Mons. J. Leonard (a past-president of the Belgian Association) were presented.

Mr. J. E. Hurst was the first speaker at the afternoon session, at which Mons. J. M. Espana—a vice-president of the French Association—presided. He dealt with the question of centrifugal casting. The Paper was exceptionally well received. He was followed by Mons. Leonard, Mons. Gil, the chairman, and Senor Ituarte.

MONS. G. MASSON,
President of the Association Technique de Fonderie (Belgium).

On Wednesday morning Signor Com. Ing. Vansetti presided, and Papers were presented by Prof. Trasenter; Mr. G. H. Clamer (past-president of the American Foundrymen's Association), Mons. Le Thomas, Mons. Levasseur and Mons. Thibaud.

In the afternoon the fortress of Loncin was visited, and an evening train was taken to Luxembourg, where the next day the visitors inspected the Belval foundries and various other works of the Société Metallurgique des Terres-Rouges. A luncheon offered by this concern afforded an opportunity for the guests to thank their hosts. Some of the more important Papers presented will be given in future issues.

The British Delegation consisted of Mr. J. E. Hurst; Major Miles, of Newton, Chambers & Company, Limited, Thorncliffe Ironworks, near Sheffield; Mr. Lunt, Mr. Bethel and Mr. Taylor. They wish to express their indebtedness to Mr. R. Eppenberger, the Paris representative of the British and Continental Traders, Limited, who was delegated by the Conference to take care of the British visitors.

R. H. PATTERSON & COMPANY, LIMITED, Forth Street Works, Newcastle-on-Tyne, have appointed A. Fleming Browne and William Sharp, 11, Charteret Street, S.W.1, as their agents for London and the South.

A Consideration of the Annealing Operation in the Malleable Foundry.*

BY C. J. MCNAMARA AND C. H. LORIG, Milwaukee, Wis.

In this Paper the authors wish to present a few simple experiments that were carried out with the object of obtaining some knowledge of the rate at which white iron graphitises. Two sets of wedges cast from different heats of an oil-fired melting furnace were selected as test specimens. As a general rule, the test pieces were of similar size; yet this feature is not essential, as they were subject only to microscopic examination. The wedges were packed in sand blast sand contained in a 1¼-in. by 7-in. nipple capped on both ends. One wedge from each heat was packed in each container in order to make a comparison between the two sets of wedges which have been given identical heat treatments. The analyses of the test wedges is that which is representative of the heat from which they were cast. The analyses and the means of designating the two sets of test pieces are as follows:—

	Si	*Mn*	*C*
H2-17 ...	1.02	0.30	2.55
H1-20 ...	0.86	0.25	2.69

In the first experiment fourteen of the containers into which wedges were packed were placed upon a stack of pots close to the front of an annealing oven. An opening in the brickwork of the front wall opposite the containers made possible their extraction by inserting a long pair of tongs. Into this opening was also placed a thermo-couple with its hot junction extending to the centre of the pile of containers. By means of a pyrometer temperature readings were taken each hour. When the temperature of 840 deg. C. was registered on the pyrometer the first of the containers was removed from the oven and then quenched in water to preserve structural conditions as they actually existed at the high temperature. Other containers were removed from the oven at intervals of five hours.

The second experiment was a repetition of the first except that the containers were located in the cooler portions between the pots near the floor of the oven. And in the third experiment the containers were removed from the annealing oven during the cooling period of the annealing cycle.

General Discussion.

Graphitisation begins very soon after the temperature rises above the transition point. In the early stages the reaction proceeds rapidly, but gradually slows down as the equilibrium point is reached. In the above experiments it would require close to sixty hours at a temperature of 815 to 840 deg. C. to insure freedom from primary cementite.

One must not forget that due to the temperature gradient between the exterior and interior of the annealing pot upon heating there is a considerable lag in the time at which the interior is brought to the temperature of the outside. On tests with thermocouples packed within the pots this lag amounted to as much as fifteen hours.

Since the problem of shortening the annealing time for malleable castings is of primary importance, it would seem that the above experiments suggest one means in reducing the actual time for the anneal. It is very probable that the last traces of cementite could be removed by overcoming equilibrium conditions. As austenite increases its solubility for carbon with a rise in temperature, why should not the small remaining areas of primary cementite pass into solution very quickly if the temperature is raised? At the same time the reaction would be benefited by the increased rate of graphitisation with higher temperatures. A hundred degrees rise in temperature should be sufficient for the purpose described.

It would seem that raising the temperature of the oven for a short while before it is allowed to cool would affect the structural and physical properties of the iron but little. The carbon globules have already been formed before the rise in temperature takes place. At the higher annealing temperatures no apparent increase in the ferrite grain sizes have been noticed. No marked variation in the physical properties would, therefore, be expected by heating the iron for a short time above the usual annealing temperature. It is to be regretted that insufficient data prevent the verification of this point.

In the annealing of malleable castings it is necessary to cool very slowly from the annealing temperature to a temperature slightly below the critical point of the iron. It is customary to cool at a rate of 5 deg. C. per hour, although it is possible to obtain good malleable castings when the rate of cooling is as high as 10 deg. C. per hour. Cooling at a rate above 10 deg. C. per hour is very likely to lead to trouble in obtaining malleable castings of good quality. Precipitation of stable cementite takes place if the cooling rate is too rapid.

Continued slow cooling below the critical point undoubtedly has little purpose in producing good malleable iron. All specimens that were removed from the annealing oven at a temperature below the critical range had the same ductility regardless of the manner in which they were cooled. The specimens quenched in water from a temperature just below the critical range were as ductile as those which were allowed to cool to room temperature very slowly.

To be certain that all the malleable castings in an annealing oven have been converted into the normal product, it is better to cool very slowly until the pyrometer records a temperature about 55 deg. C. below the critical point. This will allow the iron in the somewhat hotter interiors of the pots to be cooled below the critical point.

The excessive oxidation of the annealing pots is one bad feature resulting from opening the annealing oven at too high temperatures. The air which is sealed in the oven when it is cooling has had time to come to equilibrium with the iron of the pots. No further oxidation will result as long as the air in the oven is not displaced by a new supply. Upon opening the oven, however, the fresh supply of air which circulates about the pots upsets the equilibrium which had been set up. Excessive oxidation is sure to result if the temperature of the oven is very high.

* An extract from a Paper read before the American Foundrymen's Association.

Sheffield Foundry Technical Society.

During the coming winter the Sheffield Foundry Technical Society are to draw attention to the seriousness of the malleable cast-iron trade. This section of the trade has felt the competition of the drop-forging so severely that the trade is having a struggle to get business. Foundrymen believe that the malleable casting is the more satisfactory proposition, even when the strength of the drop-forging is taken into account, and, what is more important, it is generally a much cheaper product. Many foundrymen, unfortunately, do not realise the seriousness of the competition and the necessity for taking steps to meet it.

The discussion which the Foundry Technical Society has arranged on this subject will be opened by Dr. P. Longmuir, who is fully alive to the position, and has the advantage of a complete knowledge of the technical possibilities of both products.

Another aspect of the malleable iron casting will be taken later on in the session, when the technical details concerned with the efficient production of these castings will be considered, and the matter discussed from all points of view.

The relative position of moulding and pattern-making will also be the subject of a further discussion, and this will provide an opportunity for these two important branches of the foundry trade to understand each other's difficulties. The present-day foundryman is convinced that youths in both sections of the trade should not be considered journeymen unless they have had practical experience in both these important branches of the trade. If every moulder could read a drawing and could make patterns, it would be a valuable asset to the foundry trade.

Institute of British Foundrymen.

SHEFFIELD AND EAST MIDLANDS BRANCHES.

Visit to Chesterfield Works.

About 120 members of these Branches inspected the works of the Sheepbridge Coal & Iron Company, Limited, last Saturday week. The party included Engineer-Lieut. Commander L. Jackson, R.N. (president of the Sheffield Branch), Mr. R. Village (secretary), Mr. E. Stevenson, Nottingham (president of the East Midlands Branch), and Mr. H. Bunting (secretary), and was met by Mr. W. B. M. Jackson, managing director of the Sheepbridge Company. Mr. J. T. Goodwin, foundry manager, and Mr. E. Houghton, blast furnace manager.

First visiting the blast furnace plant, the members saw the latest type of blast furnace tapped and 25 tons of metal run into the pig beds. They were specially interested in a pneumatic tap-hole rammer. At the two foundries they saw special apparatus for pipe moulding and a layout of special beds for heavy castings, the power-house and engineering shops being also examined.

Subsequently, at the Station Hotel, Chesterfield, tea was provided by the Sheepbridge Company, under the chairmanship of Commander Jackson, Sheffield.

Mr. W. B. M. Jackson, in welcoming the company, remarked that all they were suffering from was want of trade. Cutting in prices and foreign competition had been responsible for a very bad time for all of them, and all of them, from the highest to the lowest, had got to work hard and to put the very best into their job if trade was to improve. Their ironworks at Sheepbridge, as well as those in Sheffield, were suffering on account of their inland situation. They had to pay high railway rates, which were at the bottom of a good deal of the depression from which they were suffering. He was glad to note a better feeling in the country than had existed for some time past. It was at present very largely a feeling, but he hoped that it would be maintained.

Referring to the visit to Sheepbridge Works, Mr. Jackson remarked that everything they had seen was made by the Company from A to Z. The concern was self-contained. They produced their own coal, made their own coke, mined their own ironstone, produced their own limestone, made their own pig-iron, and manufactured it into castings and wrought iron, and to a small extent they made their own steel. At present they were able to blow only one blast furnace, but he hoped they would soon see a better demand.

Mr. J. T. Goodwin expressed thanks for his election as vice-president of the Institute of British Foundrymen, and said that when he became president in 1927 he hoped they would rally round him. Science would enter more largely than ever into their industry, and it behoved all to see that the juniors in the trade were equipped with a thorough education to fit them to face the future successfully. It was the quality of their work that had brought England to the position she occupied to-day, and he trusted that every possible step would be taken to maintain that position.

Blast Furnace Practice.

MR. E. HOUGHTON, blast furnace manager at Sheepbridge Works, in a talk on "Blast-furnace Practice," led off with an oft-forgotten fact that the raw material of which foundrymen used the most—the largest weight per ton of pig-iron—cost nothing at all. That was air, a material of which nearly five tons, and sometimes more, was required per ton of pig-iron. That was a rather astonishing fact. Air, however, was not a uniform material. It contained in summer weather, such as we had been having recently, a vast amount of water, while in winter it contained very little water, and the difference between the two extremes made hundredweights of coke difference in the production of pig-iron. Still, as it cost them nothing, they could not complain, and there were means whereby the variation could be remedied. Discussing coke, he said blast-furnace coke was "what is left after the foundrymen had had their "pick." They could not be too particular about the quality of the coke. That applied both to foundry coke and blast-furnace coke. Their chief trouble was in the size. Blast-furnace coke contained a lot of breeze, which was very detrimental. It caused the sticking of the charge, and there was a risk of slips, which might cause the explosions of which one occasionally read. But at Sheepbridge they controlled their own coke, and they also largely controlled the raw material.

In the making of low-phosphorus irons, cokes had to be very carefully selected in regard to phosphorus. In high phosphorus irons it did not matter. The most interesting material in making pig-iron was the iron ore, and it was necessary to consider very carefully the analyses of the raw materials and to blend them together, so that a pig-iron could be got corresponding with the brand of the district. The brand of pig-iron, as distinct from the grade, was determined by the ores. In Derbyshire a practice in the making of iron with 1.5 phosphorus and 1.7 manganese, they had to blend the highly phosphoric ores of Northamptonshire with the highly manganiferous ores of Lincolnshire, which were low in phosphorus. By blending them together in proper proportions they produced an iron giving the analysis for which Derbyshire iron was noted. The whole of the phosphorus in the iron ore went into the pig-iron, and it was fairly simple to tell from the analysis of the raw materials what phosphorus there would be in the pig. In regard to manganese, about 50 per cent. of the manganese present in the charge would ultimately be found in the pig. In that district it was usual to find something like 60 per cent. of the manganese in the pig.

The blast furnace, it was pointed out, was not like the cupola. The blast furnace had not got a convenient door on the bottom, but was completely sealed, and whatever solid matter was put in at the top, must come out as liquid at the bottom, or go away as gases at the top. That meant that they had to take very careful steps to see that the earthy oxides, which are largely infusible by themselves, were so mixed together that there would be a slag which would melt at the temperature at which it was reasonable to run the furnace. They had to mix the silicious ores of Northants with the limey ores, or make the necessary additions with limestone. The slag had also to be calculated so that it would be sufficiently basic in character to absorb the sulphur in the charge, and not only that, but they had to have sufficient volume to make the slag absorb all the sulphur they could. On the other hand, they had to see that this slag was sufficiently fluid to flow away from the furnace freely, and that did not always agree with the other conditions. Latterly, they had also had to see that the slag produced was suitable for sale as a raw material in road-making. That, he was glad to say, had been one of the great salvations of the pig-iron industry during the trying time they had gone through—the use to which slag had been put in the making of road material in the form of tar macadam. At Sheepbridge, they were turning out considerable quantities of excellent tar macadam for use on the main roads in the district. But slag for that purpose must be on the lean side: it must not be limey, or it would fall to powder. Therefore, it would be seen that the scientific side of blastfurnace practice needed to be very much considered in the iron-making industry of the country.

In ensuring that it was sufficiently basic, one had to take care that the iron was not too high in silicon. They had seen at Sheepbridge the way in which they utilised gases for heating the blast. That was the general practice of the country, and meant a considerable saving in fuel, and it was one of the things which enabled the British pig-iron industry to hold its own. There was a vast amount of data available about pig-iron, and the Institute of British Foundrymen had done a

great deal to put everyone concerned in possession of the facts concerning pig-iron grading and analysis. One welcomed the spread of knowledge on this subject amongst foundrymen. Makers of pig-iron realised that it was to their benefit that they should know what foundrymen required. In the old days, grading by fracture was the rule, but now the rule was grading by fracture and analysis.

In conclusion, Mr. Houghton displayed four specimens of pig-iron to show how one could go wrong in ordering by grading alone. He pointed out that the samples all contained 4½ per cent. of silicon, but still that did not govern the grading.

In the discussion, MR. J. SHAW (Sheffield) asked what was the average variation of silicon and sulphur, say, from the first pig bed to the last.

MR. J. R. HYDE (Sheffield) suggested that cast iron was sadly neglected. Thousands of pounds had been spent in the research field, but cast iron had always been looked upon as something not of sufficient importance to spend money upon. Now, they had a Cast-Iron Research Association, and in the next five years progress should be made in regard to that metal. He did not advocate super-cast irons, because they did not get the "super" every time. But if a good average quality could be obtained it would be good enough to hold the future so far as cast iron was concerned. If they could maintain British quality, it would be quite good enough without paying too much attention to super qualities.

MR. HOUGHTON, replying, said, in regard to silicon and sulphur variation it was extremely difficult to say what an average was, but he suggested silicon 0.25 per cent. and sulphur 0.01 per cent. In a change from a high silicon iron to a lower one, they might get as much as 1.0 per cent., but in those cases they would need to test very carefully. As to re-melting iron similar to the specimens shown, he believed they would reproduce almost exactly, except that they would be leaner, and so the grading would have a tendency to drop.

Cordial thanks were passed to Mr. Houghton, on the initiative of ENGINEER LIEUT.-COMMANDER JACKSON (Sheffield), seconded by MR. E. STEVENSON (Nottingham).

SHEFFIELD BRANCH.

For the opening session, held at the Albany Hotel, there was a large attendance. The Branch President (Engineer Lieut.-Commander L. Jackson, R.N.) occupied the chair.

Reference was made to the death of Mr. T. H. Firth, and it was announced that a letter had been sent to Mrs. Firth from the Council, extending their deep sympathy, and the Branch meeting also passed a resolution of condolence.

The Hon. Secretary (Mr. R. Village), in a brief report of the affairs of the Branch, said that financially they were strong as compared with other Branches of the Institute. They had 192 members on the books, which was apart from subscribing firms. If those present could help in proposing possible new members, the Branch would be pleased to give all the data they could. They believed that their syllabus this year would be of interest.

THE BRANCH PRESIDENT then read a Paper on "Economics as Applied to Industry." The subject, he said, was rather off the beaten track, but he had taken it because it was a subject that affected them very deeply and intimately. To develop a works, land, labour, and capital were necessary. Land and capital were agents, but labour, he said, was not an agent, but an instrument. No one section could make the claim that it alone produced the commodities needed. It was team work that produced the maximum. He showed how products which are in request are always valued at the price of the least economically produced—the one which has to charge the highest price to become a paying proposition.

MR. J. R. HYDE agreed that this happened during the war in regard to coal. Although many mines were an uneconomic proposition, they were kept going, and the price of coal was raised to make these pits pay. Some of these uneconomic collieries were now beginning to close down, which was the first sign of a return to common sense. The sooner they all closed down the better would it be for the foundries.

A vote of thanks to the President for his Paper was proposed by Mr. G. Egington and seconded by Mr. J. Shaw.

LANCASHIRE BRANCH.

By invitation of Messrs. Newton, Chambers & Company, Limited, about eighty members of the Lancashire Branch of the Institute of British Foundrymen visited the Thorncliffe Works, near Sheffield, on Saturday, October 24.

The party met in Manchester, and travelled to Sheffield by train, reserved accommodation being provided. On arrival at Sheffield motor coaches conveyed the party to the Works, where they were met by the Managing Director, Mr. Miles, and were then entertained to lunch. Mr. Miles presided, and was supported by various representatives of the Company and by Mr. Ward, of Messrs. Hall & Pickles. The thanks of the visitors were voiced by Mr. Masters, the Branch President, Mr. Primrose, Junior Vice-President, and Mr. Makemson, Secretary.

A tour of the Works was preceded by an inspection of the cast-iron houses which Messrs. Newton, Chambers are now making. The visitors were agreeably surprised by the substantial construction and the very good appearance of these houses, and it certainly appears that this company has solved the problem of substituting iron for brickwork in building construction.

The party then proceeded to the collieries, chemical works, and coke ovens, and witnessed the withdrawal of a charge of coke and the placing in the oven of a new charge of coal. The blast furnaces were also inspected, and a "tap" was carried out whilst the party was present.

Considerable interest was shown in the foundries, which are equipped for turning out very large quantities of work of a very varied character. The work made in these foundries ranges from light castings for building purposes to large, heavy castings in loam for chemical works, etc. The plates for the cast iron houses are made on Osborne Turnover Jolt Ram Machines, the patterns are 3 ft. square, and two are mounted on each plate.

Machine shop, pattern shop, and other parts of the works were also visited, and the party were then entertained to tea by the Company before leaving by motor coaches for Sheffield on the return journey.

Company Meetings.

Glenboig Union Fire-clay Company, Limited.—MR. JAMES DUNNACHIE, chairman and managing director, presided at the annual meeting in Glasgow. It was very gratifying, he said, in a year of very acute trade depression throughout the country, to be able to submit for their approval a balance-sheet which, he was certain, would meet with their entire satisfaction. The products of the company continued to meet with a ready market, and the high standard of quality which was associated with their name was being maintained, and he thought to that fact was due a great deal of their success. Referring to the purchase of Glenboig Estate, he remarked that by doing so they had obtained many advantages, principally, he thought, security of tenure. They were now absolutely owners of their own ground and works, and had also got free of mineral royalties.

Leeds Fireclay Company, Limited.—MR. C. F. SPENCER, presiding at the thirty-sixth annual meeting, said the accounts exhibited both business progress and profits, which might in these times be considered at least satisfactory. Commenting on the balance-sheet, he pointed out that £26,410 had been spent during the year on the installation of new plant at some of the company's works, and the total expenditure in this connection would reach £35,000. The Trade Facilities Department of the Treasury had agreed to guarantee a loan to the company of that amount, secured by second debentures bearing interest at 5 per cent. The directors had under consideration a scheme for further installation of new plant at other works, and it was quite possible that such a scheme might be put into operation during the present year after the complete results of the whole of the existing new installations were before them.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.

THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS,
(MANCHESTER), LIMITED,
BLACKFRIARS, MANCHESTER.

Trade Talk.

KING, TAUDEVIN & GREGSON, LIMITED, Ward & Payne, and Camm, Bagshaw & Company have joined the Federation of British Industries.

THE IGRANIC ELECTRIC COMPANY, LIMITED, 147, Queen Victoria Street, London, have recently opened a new office at British Dominions House, Tramways Centre, Bristol.

BRITISH FURNACES, LIMITED, Chesterfield, have recently completed an order from the Royal Arsenal, Woolwich, for the supply of ten town's gas-fired recuperative forging furnaces of their patent R.B. type.

A NEW STEEL RAILWAY BRIDGE across the Nile is to be built at Dessouk, the contract for which has been placed with Dorman, Long & Company, Limited. It is understood that the contract price is in the neighbourhood of £142,000.

CAMMELL, LAIRD & COMPANY, LIMITED, of Nottingham, have received orders from the High Commissioner for India for 220 broad gauge steel coaches for the Indian State Railways, 110 being for the East Indian Railway and 110 for the North-Western Railway. Tenders for this work having been publicly advertised there was world wide competition. Cammell, Laird & Company, and their associated firms, the Leeds Forge Company, Limited, and the Midland Railway-Carriage & Wagon Company, Limited, of Birmingham, pooled their resources, and by improved methods, improved machinery, and improved designs they have been able to get their costs so low that they were able to beat the foreigner and bring the work to this country. It is well known that on recent occasions a certain amount of work of this nature has been placed on the Continent, and in the circumstances the company are to be congratulated on securing this order.

FURTHER electrification schemes are announced. The Government of India have authorised the Railway Board to proceed with an extensive main line electrification scheme on the Great Indian Peninsula Railway, the lines concerned being from Bombay to Igatpuri and Poona, these places being respectively 85 and 119 miles from Bombay. The cost of the work is estimated at seven crores of rupees, or approximately £5,000,000. Including the suburban lines already electrified, the complete scheme covers about 300 track miles. The latest project in Australia is that of the Civic authorities in Sydney to erect a new power-house at an estimated initial cost of £2,000,000. The site of the new power-house is Bunnerong Point, and preliminary work is proceeding. The plant has been planned in three units, each of which will have a capacity of 100,000 kilowatts, or exactly double the generating power of the existing power-house. The cost of erecting and equipping the first unit, which it is expected will be in operation by the end of 1928, is the amount already stated. It is estimated that the cost of the whole scheme will approach £5,000,000. The Railway Commissioners of New South Wales also are contemplating extensions.

THE DOUGLAS FORGE COMPANY, LIMITED, has gone into voluntary liquidation, having decided to cease business altogether, and the company's Scholes Bridge Forge at Wigan is being dismantled, all manufacturing operations having now been finally suspended, after a continuous and successful business record, under various owners, of nearly a century and a quarter. The works, in fact, date back to 1809, having at one period, prior to being adapted to ordinary foundry practice, been utilised as a spade manufactory. In 1873 they were taken over by the late Mr. Thomas Knowles, M.P. for Wigan, one of the founders of the Pearson and Knowles Coal and Iron Company, Limited, and in 1885 they came into the possession of Mr. Israel Knowles, who was at one time a director of the Pearson and Knowles Company, Mr. R. B. Seddon, at the time manager of the Wigan Wagon Company, and Mr. J. Eatock, who was manager of the Douglas Forge. Forty years ago Mr. J. Eatock, the manager, patented the "slide valve" for use in stationary steam engines and colliery winding engines, and this was manufactured by the Douglas Forge Company, Limited, which was formed into a limited liability company some thirty-five years ago. The reason given for the cessation of business and the dismantling of the works is the long-continued and unparalleled depression in the iron trade, which has most adversely affected the company's fortunes, though, it is stated, all creditors will be paid in full. Mr. T. Hall, of Warrington, is the chairman of directors of the company, and Mr. J. R. Knowles, who is the managing director, is a nephew of the late Mr. Thomas Knowles, M.P., and was at one time general manager of the Pearson and Knowles Collieries in the Wigan coalfield. His brother, Mr. Thomas Knowles, of New Brighton, is also a director of the Douglas Forge Company, Limited.

Obituary.

MR. W. WATTS, managing director of Vosper & Company, Limited, shipbuilders and engineers, Portsmouth, has died at Southport. Mr. Watts, who was 51 years of age, was president of the Engineering Employers' Federation.

MR. A. G. WILD, founder and manager of A. G. Wild & Company, Limited, Railway Supply Works, Darnall, Sheffield, and formerly director and general manager of W. S. Laycock, Limited, Millhouses, Sheffield, died recently.

MR. W. BLACKETT, of Newcastle, died recently in his 58th year, after a short illness. Mr. Blackett was the second and surviving son of the late Mr. Robert Blackett, of Foster, Blackett & Wilson. He was an engineer in the service of R. & W. Hawthorn, Leslie & Company, Limited, St. Peters Works, Newcastle. He commenced his apprenticeship with that firm in September, 1885, and for practically the whole of the ensuing period up to his death occupied positions of trust with the company, both in the works as manager and in the outside department. In recent years he had taken a leading part in the development of the firm's education and welfare schemes.

Contracts Open.

Annan, November 9.—Pipemaking for the Annan District Committee. Warren and Stuart, 94, Hope Street, Glasgow. (Fee £2 2s., returnable.)

Bradford, November 14.—Iron and steel, etc., for 12 months from January 1, for the Tramways Committee. Mr. R. H. Wilkinson, general manager, 7, Hall Ings.

Dublin, November 12.—Iron and steel, etc., for six months from January 1, for the Great Northern Railway (Ireland). The General Stores Depôt, Dundalk. (Fees 1s. each.)

Lahore, November 30.—Iron and steel, etc., for the North-Western Railway. The Executive Engineer, Permanent Way, North-Western Railway, Lahore. (Fee, Rs.5 (say, 7s. 6d.), non-returnable.)

London, S.E., November 10.—Cast-iron pipes, etc., for the Director-General, India Store Department, Branch No. 14, Belvedere Road, Lambeth, London, S.E.1.

Montevideo, January 4.—Copper and bronze sheets, etc., for the State Electricity Supply Works. The Department of Overseas Trade. (Ref. No. A.X. 2,471.)

Southport, November 19.—Pumping plant for the Southport, Birkdale and West Lancashire Water Board. Mr. C. B. Ede, engineer and manager, 14, Portland Street, Southport. (Fee £2, returnable.)

Personal.

MR. C. COOKSON has been elected a director of the Consett Iron Company, Limited. He is a director of the Cookson Lead & Antimony Company, Limited.

JUDGE E. H. GARY, chairman of the United States Steel Corporation, has received the honorary degree of Doctor of Commercial Science from New York University.

MR. P. W. PETTER has been nominated for election as Mayor of the Borough of Yeovil for the ensuing period. Mr. P. W. Petter has for 25 years been the managing director of the firm of Petters, Limited.

MR. A. H. DARKER, chief electrical engineer to J. Stone & Company, Limited, Deptford, S.E., has left this country on a business tour through India, Ceylon, Burma, Australia, New Zealand and America.

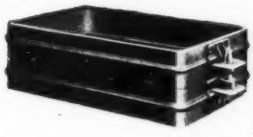
MR. H. STEWART CRAIG, at present commercial manager of the Carnforth Hematite Iron Company, Limited, has been appointed commercial manager of the Millom and Askam Hematite Iron Company, Limited.

Wills.

SIMPSON, E. P., of Fir Cottage, Bracknell, Berks, a director of Worthington-Simpson, Limited	£20,579
STRONG, H. O., of Bristol, founder of H. O. Strong & Sons, engineers	£11,841

WITHIN THE PAST few weeks Thos. W. Ward, Limited, of Sheffield, have purchased the following vessels for breaking-up purposes:—Liner "Canopic," 12,268 tons gross; liner "Orontes" (now named "British Trade"), 9,023 tons gross; steamship "Hellenes," 3,332 tons gross; steamship "Honorius," 3,476 tons gross; paddle steamer "La Marguerite," 1,554 tons gross; and dredger "Tantalus," 748 tons gross.

Sterling



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(*Continued from page* 380.)

of the test bars white iron was secured for about ½ in. in depth. This I half expected because the mould had been irregularly heated. The portion of the mould which produced white iron was only heated to about 150 deg. C., whilst the temperature in other extremes of the mould rose to about 300 deg. C. Metal poured from the same shank into a green and a cold dry-sand mould only resulted in white iron.

My belief is that the information the makers of Perlit Iron can now bring out into the open is the system whereby they instruct and give calculations of the temperatures of moulds and metal and cross temperatures for varying sections or for average sections; also the mixtures of metal (brands, etc.), the analysis being familiar. I mention brands and metal because when mixing one may try many brands of pig, etc., white, mottled and grey iron, and arrive at the required analysis in a variety of ways, but may not secure pearlitic cast iron until just the right brands are secured. Mr. Young has stated, I believe, that metal of same analysis arranged from different mixtures will give the same results. I agree that that should be so. But do we secure the correct analysis? Chemists analyse and give us carbon, silicon and so on, but never the gases present in the metal.

In my opinion the contradictory results obtained when mixing different brands of pig-irons in a variety of ways for obtaining the same orthodox analysis can be ascribed to the action of gases dissolved during smelting and melting and occluded during cooling.

FIG. 3.—LOW CARBON PEARLITE SURROUNDING SECONDARY GRAPHITE—NEAR THE CENTRE IS CARBIDE-PHOSPHIDE, HAVING A SMOOTH SURFACE ×600 DIAS.

My opinion concerning the damaging effect of mould gases on the soundness of castings has been previously stated. In this connection I would like to state that if a mould is thoroughly dried and heated, no matter what quality of metal is used, excellent results can be obtained. If necessary (and I do not advocate it) the metal can be poured sluggish and at a low temperature without ill effect. Less gas is immediately present in the mould, consequently there is less gas reaction and the metal flows more easily in the warm mould.

"A Foundry Director" mentions the quality of metal poured into internal combustion and steam engine castings. After a wide experience in the production of gas, oil and steam engines I am forced to the same conclusion as himself, that iron of low tensile strength will stand up better to wear in the case of liners. But for the breach ends of combustion chambers and pistons and the like, I find that the nearer the approach is to a completely pearlitic iron the better. I should strongly advocate the use of pearlitic or "Perlit" Iron for such castings. The duty now fulfilled by such castings will eventually compel the use of such materials. For liners a hard iron of moderate strength, say 11 tons tensile, gives better results than metal giving considerably higher strengths and made from dearer metals. For instance, I have used metal made up of a famous brand of a No. 4 refined pig-iron, for combustion chambers used in large blowing engines from 1,000 h.p. upwards and fractured castings had been unknown. But for the cylinder liners, both in the engine and the blowing tub, the same metal would wear out in a very short time. Cheaper brands of iron equal to Midland brand gave better results. Yet the former had a silicon 1.25 per cent., and silicon in the latter was about 2.85 per cent. Gears cast in such metal as the latter also stand wear much better than the former.—Yours, etc.,

E. LONGDEN.

1, Carlbourne Villas,
Main Street,
Menston, Leeds.

"Perlit," Propellers and Diesel Engine Liners.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your issue, dated October 29, you published a letter from an "anonymous" writer, who states that his "object is to try to bring the Perlit Iron people out into the open!"

I would like to point out to you that the utmost publicity has been and is being given to this new process for making "Perlit" Iron, and the items mentioned by your correspondent can only be dealt with at meetings of Technical Societies, when this matter is under discussion.

Our Consulting Metallurgist (Mr. H. J. Young, F.I.C.) has already given the following "public" lectures:—

Glasgow Conference, I.B.F., at Glasgow, on June 11, 1925.

Newcastle Branch, I.B.F., at Newcastle, on September 26, 1925.

Manchester Metallurgical Society and Manchester Branch, I.B.F., at Manchester, on October 21, 1925;

and the following, *inter alia*, are also to be given, when your correspondent may raise the points referred to in his letter:—

West Riding of Yorkshire Branch, I.B.F., at Leeds, on December 12, 1925.

London Branch, I.B.F., at London, on January 14, 1926.

West of Scotland Iron and Steel Institute, at Glasgow, on February 12, 1926.—Yours, etc.,

THE BRITISH PERLIT IRON COMPANY LIMITED.
JOHN A. SMEETON,
Managing Director.

15, Victoria Street,
London, S.W.1.

"Sandslinger" Developments.

Foundry Plant & Machinery, Limited, of Glasgow, have disposed of the sectional patent rights in the Beardsley Piper Sand Slinger Moulding Machine, in so far as they are applicable to the production of malleable iron castings, to Messrs. Leys Malleable Castings Company, Limited, of Derby. Delivery of four sand slinger machines was made this week to Messrs. The Citroën Motor Car Company, of Paris. These machines are to be installed in conjunction with turntables and continuous conveyors, in the manufacture of iron cylinders and aluminium crank cases.

Other recent orders are reported from Messrs. Smith, Patterson & Company, Limited, of Blaydon-on-Tyne; this is a repeat order, but in this case is to be of the motive type. This type of machine has also been ordered by William Asquith (1920), Limited, of Halifax. Other recent plant installations are Clarke, Chapman & Company, Limited, Newcastle; Davey, Paxman & Company, Limited, Colchester; J. Williams & Sons (Cardiff) Limited, Cardiff.

MR. C. HOWELL KAIN, who has served his apprenticeship as a moulder at the English Electric Works at Preston, has been awarded by the City and Guilds of London Institute, Department of Technology, the silver medal and also the first prize of £3 granted by the Ironmongers' Association. He studied metallurgy at the Manchester University.

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PLUMBAGO,
CORE GUM,
WHITE DUST,
COAL DUST.

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Following the more active conditions prevailing during the past few weeks, business in the Cleveland iron markets has assumed a quieter aspect, the majority of home consumers having satisfied their requirements over the remainder of the year, while reserving forward commitments for a later period. The market meanwhile remains steady and, on the whole, there is a feeling of greater confidence in the outlook, at all events, in the home trade, and whilst there is still some hesitancy, the opinion gathers strength that the corner is at long last being turned. There is, of course, a vast amount of leeway to be made good, particularly in connection with the export trade. The financial conditions in France and the further sharp decline of the franc tend to make the situation acutely uncertain, and the financial stringency in Germany is also a serious obstacle to trade development. Quotations are inclined to be weaker, and in some cases are quoted 6d. down: No. 1, 69s.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s; and No. 4 forge, 64s. 6d. per ton.

The Tees-side market for hematite continues fairly active on home consumers' account, the volume of business in this section marking a satisfactory improvement. There have also been some moderate sales reported for America, and altogether the outlook is more hopeful. Quotations are unchanged, but are undoubtedly firmer, 74s. 6d. per ton representing a minimum figure for East Coast mixed numbers, and 75s. per ton the No. 1 quality. On the North-West Coast Bessemer mixed numbers remain at £4 1s. 6d. c.i.f. Welsh ports, £4 4s. per ton delivered at Glasgow, £4 7s. per ton delivered at Sheffield, and £4 12s. 6d. per ton delivered at Birmingham.

LANCASHIRE.—In the Manchester foundry iron market there seems to be rather more disposition now to buy for forward delivery. Sellers of Derbyshire No. 3 are still fairly firm at 73s. per ton for delivery in Manchester, and sellers of Lincolnshire at 72s. 6d., but there is not so much of the latter offering. Northamptonshire No. 3 is not offered here to any extent, and probably finds a better market in the Midlands, where the railway rate is not so oppressive. Some consumers here still hold to the belief that Derbyshire iron will come down to 70s. in Manchester, but they are scarcely so confident as they were on this point.

THE MIDLANDS.—A fair volume of business is again reported in the local markets for foundry pig, but generally foundrymen confine purchases to just sufficient tonnage for immediate requirements. Ruling quotations are as follow:—Derbyshire No. 3 foundry, 64s. 6d. to 66s.; Staffordshire No. 3 foundry, 65s. 6d.; Northants. No. 3 foundry, 62s. 6d.

SCOTLAND.—The more active buying experienced in local markets recently has subsided, and business in foundry pig is again reduced to limited proportions. Little interest is being taken in Scotch iron, and the policy of hand-to-mouth buying is fairly general, prices showing an easier tendency, with No. 3 foundry quality quoted 78s. per ton f.o.t. at furnace.

Finished Iron.

In this branch, notwithstanding reports of increased inquiry, conditions are rather irregular and disturbing. Local makers are being subject to very severe competition from other districts, particularly Lancashire. Crown bars from other districts are still being offered in the Birmingham market at £11 10s., and much as South Staffordshire makers are opposed to a lower basis for this quality iron, they are being forced to meet the competition. Consequently, although the general outlook is so much better, crown bars are being sold at considerably less than they were a month or five weeks ago, and in the meantime there has been nothing to cause a considerable decrease in production costs. Fortunately, an improved inquiry for best irons for railway and wagon building purposes is reported, and so far it has been possible to uphold the price of these high-grade irons. The common bar trade is being squeezed in the same way, and although tube manufacturers are reported to be particularly busy, the call is overwhelmingly for steel strip rather than iron. Iron strip seems to be on the rock-bottom demand.

Steel.

In the steel market reports of better inquiries exist side by side with low and mostly weak quotations. There seems to be no doubt as to the improved demand for structural steel, but as yet there is no sign of firmer prices for angles and plates, no doubt because of the very fierce cutting by producers in other districts. The only direction in which there is any improvement is in galvanised sheets, makers of which are now very well sold.

Metals.

Copper.—With values of standard now steadily established above the £62 level, market conditions have been exceptionally active, and, under sustained buying for delivery early next year, quotations have developed further strength, the close being firm, with both cash and three months higher. Current quotations:—*Cash*: Thursday, £62; Friday, £62 2s. 6d.; Monday, £62 7s. 6d.; Tuesday, £62 5s.; Wednesday, £62 5s.

Three Months: Thursday, £62 17s. 6d.; Friday, £63; Monday, £63 7s 6d.; Tuesday, £63 5s.; Wednesday, £63 5s.

Tin.—Movements in this section of the market consistently point to still further appreciation of the present high values of the metal, due to a well-rooted belief that the depletion of the available supplies will become accentuated within the next few months, while it is even contended that consumption is now more than sufficient to absorb the current production. The scarcity of Straits tin on the spot seems like becoming acute, and this tends to throw more demand on the moderate supply of English tin. Prices for either Banca or Java tin are held for figures at well over London parity. Current quotations:—*Cash*: Thursday, £285 5s.; Friday, £286 5s.; Monday, £285 10s.; Tuesday, £282; Wednesday, £280.

Three Months: Thursday, £284 5s.; Friday, £284 15s.; Monday, £283 10s.; Tuesday, £281; Wednesday, £279 15s.

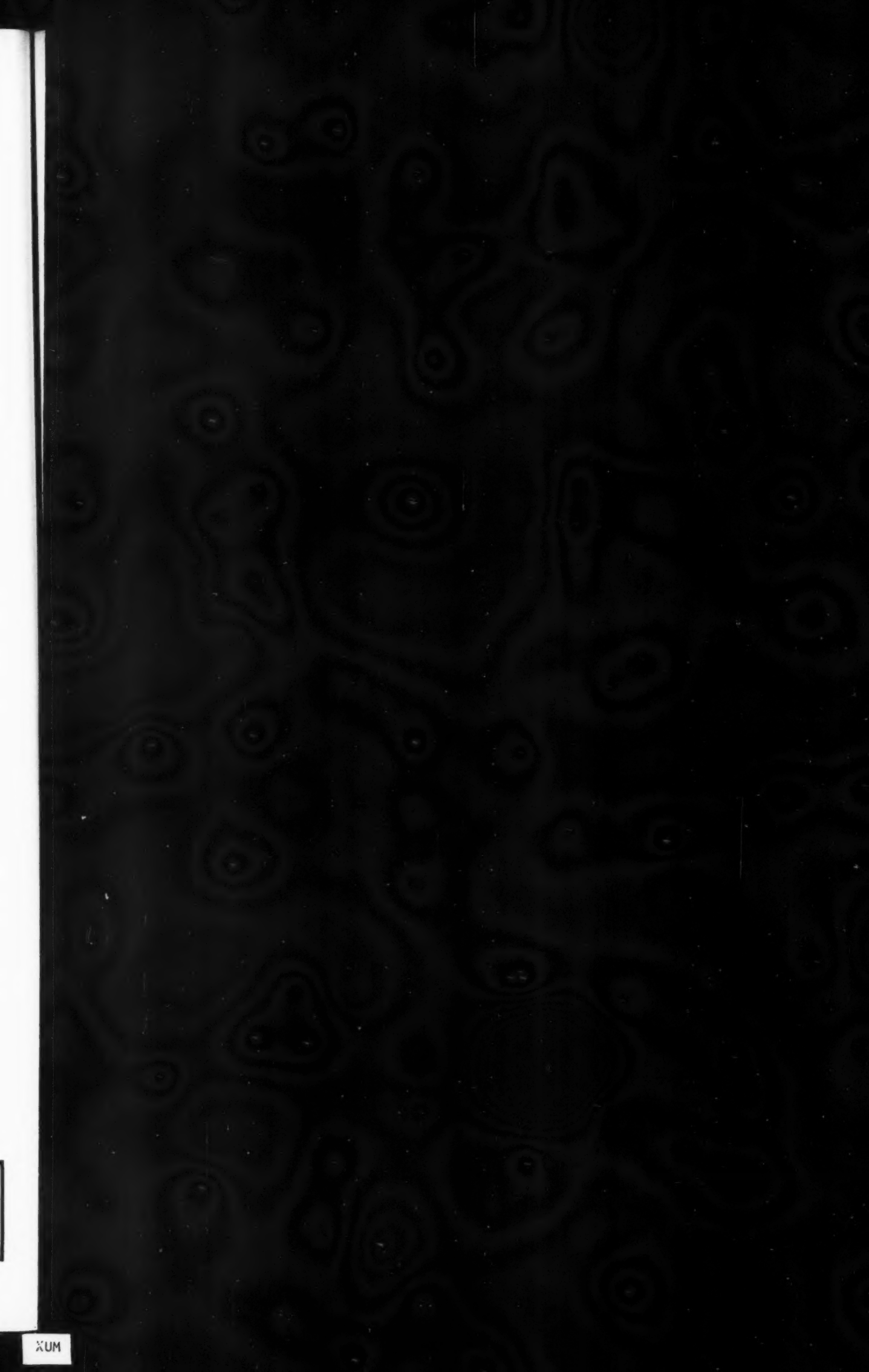
Spelter.—Notwithstanding the higher prices offered, stocks have been reduced to a point not reached for several years, estimates varying between about 15,000 tons and 20,000 tons, as compared with about 35,000 tons to 38,000 tons in the earlier part of this year. The Belgian output has been falling for months past, while, as is known, the American production has continued almost stationary. Current quotations:—*Ordinary*: Thursday, £39 17s. 6d.; Friday, £40; Monday, £39 16s. 3d.; Tuesday, £39 16s. 3d.; Wednesday, £39 16s. 3d.

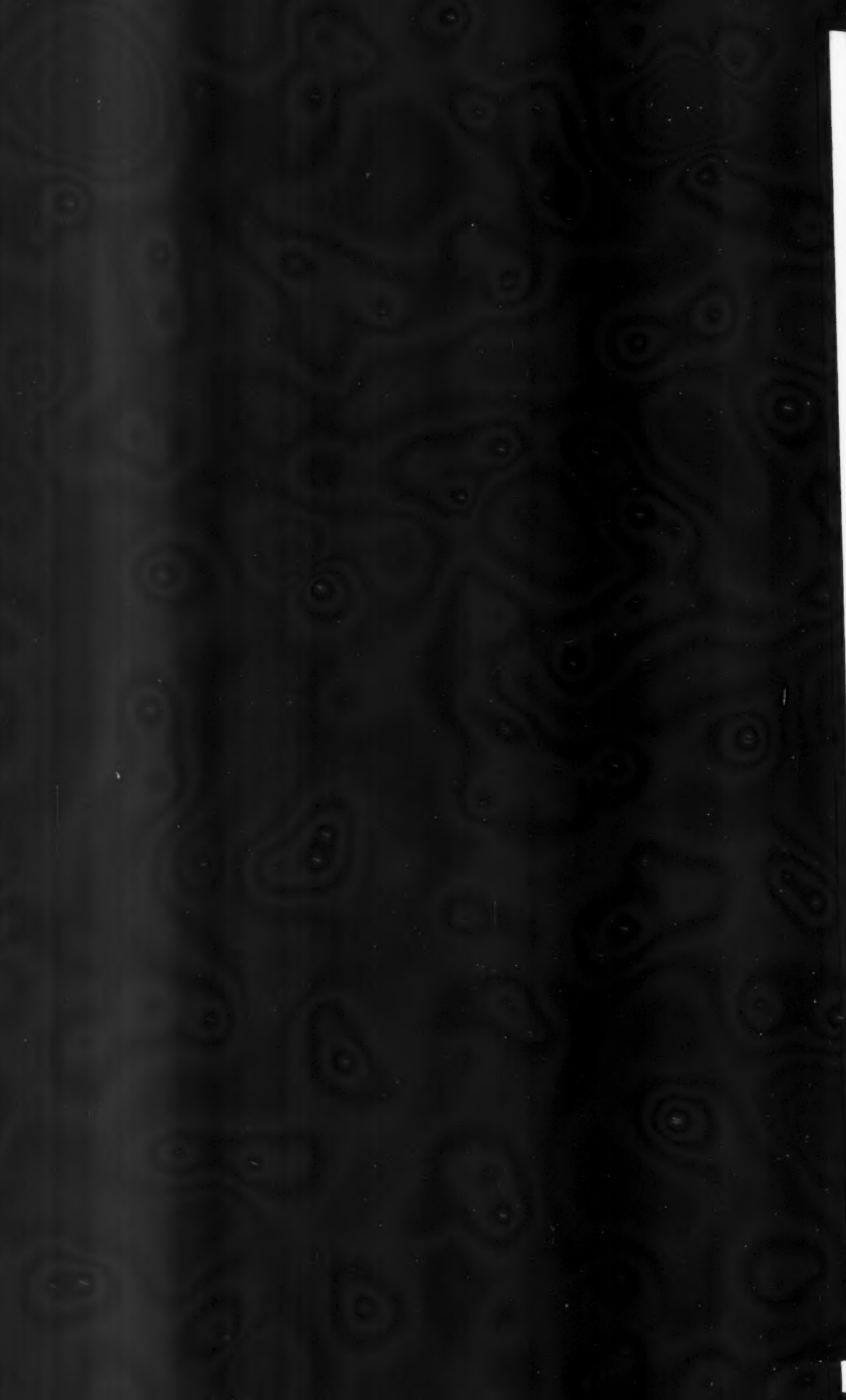
Lead.—The market for soft foreign pig is again attracting speculative attention, owing to the somewhat uncertain outlook from the statistical standpoint. Arrivals in September were comparatively small at roughly 19,000 tons, against recent very full supplies averaging about 23,500 tons a month, which approximates to the home consumption for some time past, but the supply position is now rather easier than was anticipated, 10,000 tons having been imported up to October 18. The relief in the tension is reflected in the narrowing of the backwardation. Current quotations:—*Soft foreign (prompt)*: Thursday, £38 12s. 6d.; Friday, £38 15s.; Monday, £38 12s. 6d.; Tuesday, £37 17s. 6d.; Wednesday, £37 7s. 6d.

THE GOLDENDALE IRON COMPANY, LIMITED, Tunstall, Staffs, have recently carried out many improvements and thoroughly overhauled their blast-furnace plant. Westoby & Rawstron, 326-7, Royal Exchange, Manchester, who for nearly twenty years have represented the Goldendale Company as district agents, have now been entrusted with the sole selling for the whole of their pig-iron output.

FOUNDRY REQUISITES.
Try our REFRACTORIES.
Ganister or Silica Bricks and Blocks (any shape or size).
Sands, Cements, Ganister.—*Let us have your enquiries.*
THE CLEVELAND MAGNESITE & REFRACTORY CO., LTD.,
Normanby Brickworks, Normanby, Eston, Yorks.

ERITH LOAM
J. PARISH & CO.,
ERITH.





GOLDENDALE

THE PREMIER

CYLINDER PIG IRON

SELECTED, FRACTURED & SUPPLIED TO ANALYSIS.

DENSE GREY FRACTURE

UNRIVALLED FOR CLEANLINESS & FLUIDITY.

EXCELLENT MACHINING QUALITIES.

SUITABLE FOR
STEAM, HYDRAULIC, GAS & OIL ENGINES.
HIGH CLASS ELECTRICAL CASTINGS.

SPECIAL QUALITY FOR AUTOMOBILE & AERO ENGINES.

MAKERS :-
GOLDENDALE IRON COMPANY LTD., STOKE ON TRENT.
Contractors to THE ADMIRALTY, WAR OFFICE, HOME & COLONIAL GOVERNMENTS & RAILWAYS.

SOLE AGENTS :-
WESTOBY & RAWSTRON
326 & 327, ROYAL EXCHANGE, MANCHESTER.

ENQUIRIES SOLICITED.

TELEGRAMS: "RAWSTRON." TELEPHONE: CITY 1405.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	62	5	0
Three months	63	5	0
Electrolytic	69	0	0
Tough	64	0	0
Best selected	65	10	0
Sheets	92	0	0
India	79	0	0
Wire bars	69	10	0
Do. Nov.–Dec.	68	15	0
Do. Jan.	68	7	6
Ingot bars	68	15	0
H.C. wire rods	73	5	0
Off. av. cash, Oct.	62	0	9 5/11
Do., 3 mths. Oct.	62	18	9
Do., Sttlmnt, Oct.	62	0	6 3/11
Do., Electro, Oct.	67	14	3 9/11
Do., B.S., Oct.	65	1	11½
Aver. spot price copper, Oct.	62	0	6¾
Do., wire bars, Oct.	67	18	2¼
Solid drawn tubes			13½d.
Brazed tubes			13½d.
Wire			10d.

BRASS.

Solid drawn tubes	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	10½d.
Wire	10½d.
Rolled metal	10½d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	280	0	0
Three months	279	15	0
English	280	0	0
Bars	284	0	0
Straits	292	0	0
Australian	287	0	0
Eastern	289	15	0
Banca	284	0	0
Off.aver. cash, Oct.	277	17	3 1/13
Do., 3 mths., Oct.	278	0	11 13/13
Do., Sttlmt. Oct.	277	16	9 1/13
Aver. spot., Oct.	277	16	9¾

SPELTER.

	£	s.	d.
Ordinary	39	16	3
Remelted	37	5	0
Hard	31	15	0
Electro 99.9	44	7	6
English	40	10	0
India	32	15	0
Zinc dust	45	0	0
Zinc ashes	15	0	0
Off. aver., Oct.	39	5	4 17/20
Aver., spot, Oct.	39	17	8

LEAD.

	£	s.	d.
Soft foreign ppt.	37	7	6
English	38	15	0
Off. average, Oct.	37	19	0¾
Average spot, Oct.	39	0	4

ZINC SHEETS, &c.

Zinc sheets, English	46	0	0
Do. V.M. ex whf.	45	0	0
Rods	52	10	0
Boiler plates	44	0	0
Battery plates	44	10	0

ANTIMONY.

Special brands. Eng.	80	0	0
Chinese	71	10	0
Crude	63	0	0

QUICKSILVER.

Quicksilver	14	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon 45/50%	£12 0 0
Ferro silicon 75%	£21 5 0
Ferro-vanadium—35/40%	15/9 lb. va.
Ferro-molybdenum—70/75% c. free	6/3 lb.
Ferro-titanium—23/25% carbonless	1/1 lb.
Ferro-phosphorus, 20/25%	£22 0 0
Ferro-tungsten—80/85%,c.fr.	1/8 to 1/8½ lb.
Tungsten metal powder—98/99%	1/11 to 1/11½lb.
Ferro-chrome—4/6% car.	£23 10 0
Ferro-chrome—6/8% car.	£23 0 0
Ferro-chrome—8/10% car.	£22 10 0
Ferro-chrome—Max. 2% car.	£41 10 0
Max. 1% car.	£51 0 0
Max.0.70% car.	£56 10 0
70% carbonless	1/5 lb.
Nickel—99%, cubes or pellets	£170 to £175
Cobalt metal—98/99%	10/– lb.
Aluminium 98/99%	£120
Metallic Chromium—96/98%	3/9 lb.
Ferro-manganese (net)—76/80%, loose	£15 7 6
76/80%, packed	£16 7 6
76/80%, export	£15 5 0
Metallic manganese—94/96%, carbonless	2/– lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	s. d. 2 6
Finished bars, 18% tungsten	3 0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. and over	4d.lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Do. under ¼in. to 1/16 in.	1/– lb.
Flats, ½in. × ¼in. to under 1 in. × ⅜ in.	3d. lb.
Do. under ½in. × ¼in.	1/– lb
Bevels of approved sizes and sections	6d. lb.
Bars cut to length	10% extra

Scrap from high-speed tool steel—

Scrap pieces	3d.
Turningds andwarf	1d.

Per lb. net, d/s steel makers' work

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Hvy. steel	3	7	6	to 3	10	0
Bundled steel & shrngs.	3	3	0	to 3	6	6
Mixed iron & steel	3	2	6	to 3	5	0
Heavy cast iron	3	5	0	to 3	7	6
Good machinery for foundries	3	7	6	to 3	10	0
Cleveland—						
Heavy steel	2	18	0			
Steel turnings	1	17	6			
Cast iron borings	1	15	0			
Heavy forge	4	5	0			
Bushelled scrap	3	0	0			
Cast-iron scrap	3	2	0			
Lancashire—						
Cast-iron scrap	3	10	0			
Heavy wrought	3	5	0			
Steel turnings	2	0	0			

London — Merchants' buying prices delivered yard.

Copper (clean)	54	0	0
Brass (clean)	41	0	0
Lead (less usual draft)	34	0	0
Tea lead	30	0	0
Zinc	28	0	0
New aluminium cuttings	94	0	0
Braziery copper	49	0	0
Gunmetal	48	0	0
Hollow pewter	195	0	0
Shaped black pewter	142	0	0

PIG-IRON.

(f.o.t. unless otherwise stated).

N.E. Coast—	
Foundry No. 1	69/–
Foundry No. 3	66/–
Foundry No. 4	65/–
Forge No. 4	64/6
Hematite No. 1	75/–
Hematite M/Nos.	74/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	84/–
,, d/d Birm.	92/6
Midlands—	
Staffs common*	—
,, No. 4 forge	62/6
,, No. 3 foundry	65/6
Shrops. basic	70/–
,, Cold blast, ord.*	185/–
,, ,, roll iron*	190/–
* d/d Birmingham.	
Northants forge	56/–
,, fdry No. 3	62/6
Derbyshire forge	60/–
,, fdry. No. 3	65/3
,, basic	65/–
Scotland—	
Foundry No. 1	83/6
,, No. 3	78/6
Hem. M/Nos.	78/6
Sheffield (d/d district)—	
Derby forge	64/–
,, fdry. No. 3	68/6
Lincs. forge	66/–
,, fdry. No. 3	68/6
E.C. hematite	85/–
W.C. hematite	87/–
Lincs. (at furnaces)—	
Forge No. 4	60/–
Foundry No. 3	62/6
Basic	65/–
Lancashire (d/d eq. Man.)—	
Derby forge	67/6
,, fdry. No. 3	73/–
Northants foundry No. 3	75/3
Dalzell, No. 3	110/–
Summerlee, No. 3	96/–
Glengarnock, No. 3	96/–
Gartsherrie, No. 3	96/–
Monkland No. 3	96/–
Coltness, No. 3	96/–
Shotts, No. 3	96/–

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars(cr.)	11	5	0	to 12	10	0
Angles				11	10	0
Tees to 3 united ins.				12	0	0
Nut and bolt				11	0	0
Hoops	14	0	0	to 15	0	0
Marked bars (Staffs.) f.o.t.				14	10	0
Gas strip	12	10	0	to 12	15	0
Bolts and nuts ⅜ in. × 4 in.				16	15	0
Steel—						
Ship plates	7	15	0	to 8	7	6
Boiler plts.				11	10	0
Chequer plts.	£9	15	0	to 10	5	0
Angles	£7	5	0	to 7	15	0
Tees	£8	5	0	to 8	15	0
Channels	£7	0	0	to 7	10	0
Joists	£7	5	0	to 7	15	0
Rounds and Squares 3 in. to 5½ ins.				8	15	0
Rounds under 3 in. to ⅜ in.				8	10	0
Flats, over 5 in. wide and up				9	5	0
Flats, 5in. to 1½in.				8	5	0
Rails, heavy				8	0	0
Fishplates				12	10	0
Hoops (Staffs.)				10	10	0
Black sheets, 24g.				11	5	0
Galv. cor. sheets, 24g.				16	10	0
Galv. fencing wire 8g. plain				14	0	0
Billets,soft	£6	0	0	to 7	10	0
Billets, hard				8	12	6
Sheet bars	£6	5	0	to 6	10	0
Tin bars d/d	£6	5	0	to 6	10	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	4
Rods	1	3
Tubes	1	8½
Castings	1	2

Delivery 3 cwt. free

10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.

C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/– to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	22.26
No. 2 foundry, Valley	20.76
No. 2 foundry, Birm.	19.00
Basic	20.26
Bessemer	21.26
Malleable	20.76
Grey forge	20.26
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	2.00
Tank plates	1.80
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.40
Sheets, black, No. 28	3.10
Sheets, galv., No. 28	4.20
Sheets, blue an'l'd, 9 & 10	2.25
Wire nails	2.60
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplate, 100 lb. box	£5.50

COKE (at ovens).

Welsh foundry	37/6
,, furnace	27/6
Durham & North.	
,, foundry	33/– to 35/–
,, furnace	15/–
Other Districts, foundry	33/– to 35/–
,, ,, furnace (basis)	11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	19/9
,,	28×20, ,,	39/6
,,	20×10, ,,	29/4½
,,	18¾×14, ,,	20/9
C.W.	20×14, ,,	18/1½
,,	28×20, ,,	36/1½
,,	20×10,	25/3
,,	18¾×14, ,,	18/9

Terneplates 28 × 20, 36/– per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£19/0 to £20/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£10 to £14

Pig-iron £6 15 0 to £7 0 0 all f.o.b. Gothenburg.

TUBES.

Up to and incl. 6 in.

Gas .. 55% } Tube prices
Water .. 50% } are
Steam .. 45% } now free.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Oct. 29	62	0	0	No change
„ 30	62	2	6	inc. 2/6
Nov. 2	62	7	6	„ 5/-
„ 3	62	5	0	dec. 2/6
„ 4	62	5	0	No change

Electrolytic Copper.

	£	s.	d.	
Oct. 29	67	15	0	No change
„ 30	67	15	0	„ „
Nov. 2	68	10	0	inc. 15/-
„ 3	69	0	0	„ 10/-
„ 4	69	0	0	No change

Standard Tin (Cash).

	£	s.	d.	
Oct. 29	285	5	0	inc. 82/6
„ 30	286	5	0	„ 20/-
Nov. 2	285	10	0	dec. 15/-
„ 3	282	0	0	„ 70/-
„ 4	280	0	0	„ 40/-

Tin (English ingots).

	£	s.	d.	
Oct. 29	285	5	0	inc. 80/-
„ 30	286	5	0	„ 20/-
Nov. 2	285	10	0	dec. 15/-
„ 3	282	0	0	„ 70/-
„ 4	280	0	0	„ 40/-

Zinc Sheets (English).

	£	s.	d.	
Oct. 29	46	0	0	No change
„ 30	46	0	0	„ „
Nov. 2	46	0	0	„ „
„ 3	46	0	0	„ „
„ 4	46	0	0	„ „

Spelter (ordinary).

	£	s.	d.	
Oct. 29	39	17	6	inc. 2/6
„ 30	40	0	0	„ 2/6
Nov. 2	39	16	3	dec. 3/9
„ 3	39	16	3	No change
„ 4	39	16	3	„ „

Lead (English).

	£	s.	d.	
Oct. 29	40	0	0	inc. 5/-
„ 30	40	0	0	No change
Nov. 2	39	10	0	dec. 10/-
„ 3	39	5	0	„ 5/-
„ 4	38	15	0	„ 10/-

British Monthly Output of Steel Castings in 1,000's of tons:

	1925.	1924.	1923.	1922.	1921.	1920.		1925.	1924.	1923.	1922.	1921.	1920.
January ..	13.3	12.7	9.9	6.2	15.1	—	July	13.4	15.3	11.7	7.7	6.4	18.5
February ..	14.0	16.0	11.6	7.0	15.5	17.0	August ..	11.0	12.7	13.0	8.6	9.4	17.3
March	13.6	16.1	13.6	7.4	14.2	19.0	September ..	12.8	14.0	13.6	9.5	9.2	19.0
April	12.4	14.6	12.6	4.9	6.4	17.0	October ..	—	15.1	13.3	9.4	8.2	16.4
May	13.7	16.6	14.3	3.6	2.2	18.0	November ..	—	13.9	14.8	9.1	7.7	16.2
June ..	11.5	13.8	13.8	4.9	1.9	16.0	December ..	—	12.8	11.9	7.9	7.2	18.0

AVERAGE MONTHLY PRICES OF FERRO-MANGANESE (80 PER CENT.)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1914	9 12 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	11 0 0	12 5 0	11 6 3	10 7 6	10 7 6	9 10 8½
1915	11 0 6	12 10 0	14 10 0	15 0 0	17 15 0	20 0 0	20 0 0	20 0 0	20 0 0	20 0 0	20 0 0	20 0 0	17 11 3½
1916	20 0 0	22 10 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	52 0 0	25 0 0	25 0 0	25 0 0	23 10 10
1917	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0
1918	25 0 6	26 10 0	25 0 0	*	*	*	*	*	*	*	*	*	25 10 0
1919	*	*	*	*	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	24 10 0	23 0 0	25 10 0	24 14 3
1920	27 18 0	30 0 0	31 17 6	35 0 0	37 0 0	37 0 0	37 0 0	37 0 0	37 0 0	37 0 0	36 10 0	33 16 0	34 15 1½
1921	31 0 0	27 5 0	23 12 6	21 18 0	21 0 0	18 0 0	18 0 0	18 0 0	17 2 0	16 0 0	15 6 0	15 0 0	20 3 1½
1922	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0
1923	15 0 0	15 0 0	16 0 0	17 5 0	18 0 0	18 0 0	18 0 0	18 0 0	18 0 0	17 15 0	17 0 0	17 0 0	17 1 8
1924	17 0 0	17 0 0	17 0 0	17 0 0	17 0 0	17 0 0	16 10 0	14 10 0	13 10 0	13 10 0	14 3 4	14 15 0	15 14 10½
1925	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 9 0	15 7 6	15 7 6	15 7 6	—	—	—

* Not quoted.

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No Tender received after that time will be considered.

The Contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and Form of Contract and in the London County Council Gazette.

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